THE ELECTRICAL WORLD

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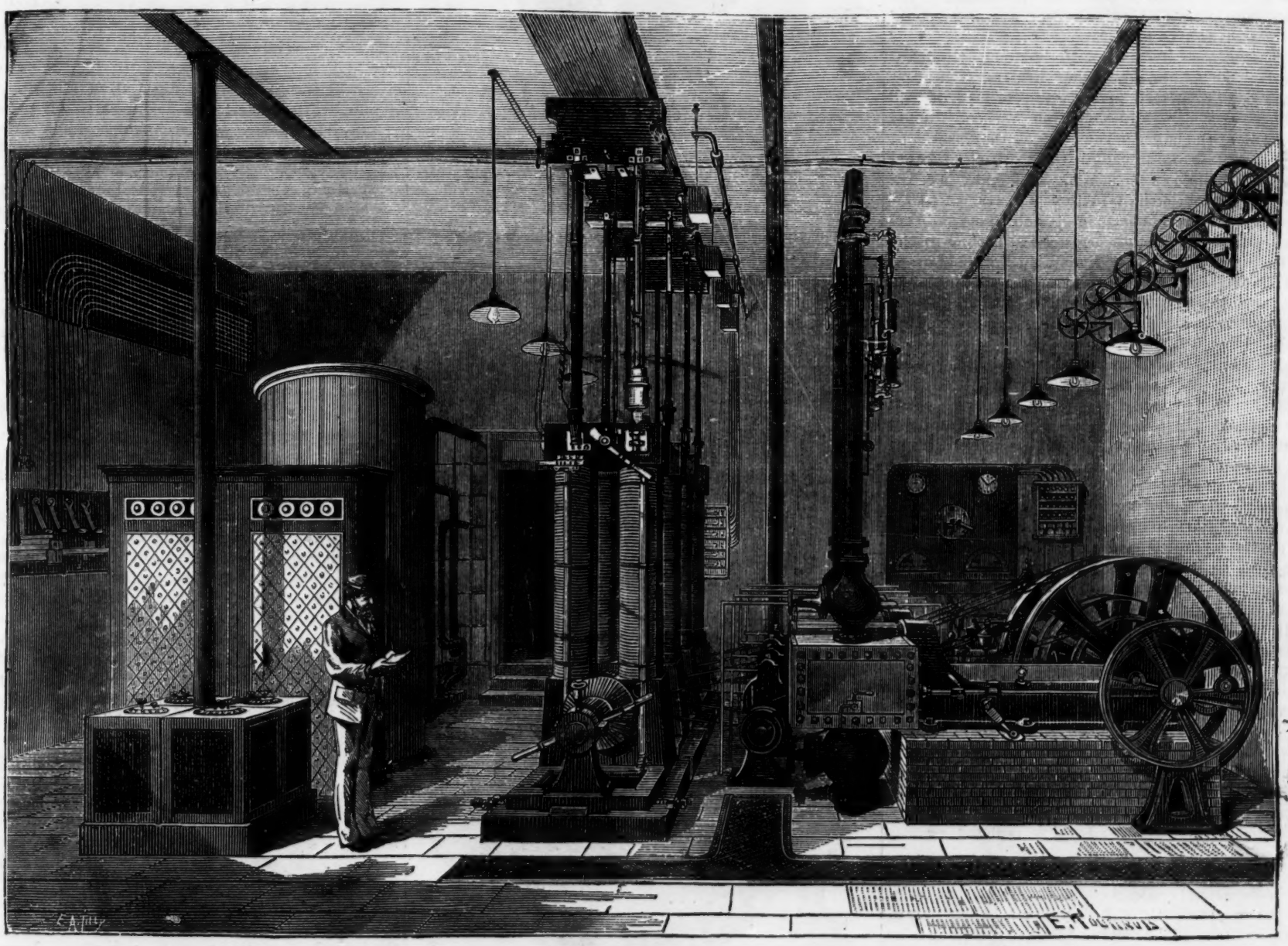
The Edison Electric Lighting Station, at Berlin, Germany.

We have from time to time given our readers illustrations of the leading electric light stations in this country and in Europe. Up to the present time, however, the central station has been peculiarly an American institution, and the stations in Europe have been few, generally small, and very widely distributed geographically. One of the things that most struck Mr. W. H. Preece when he was in the United States this year was the number, size and excellent equipment of the electric light stations for public electrical illumination, and in his paper read before the English Society of Arts given in this issue on page 265 he mentions many of the stations that he visited. In England at this moment the new central Victoria station in London, of which we have already published details, is attracting considerable local attention, and presents many notable features, but we doubt whether it would awaken so much lively interest here as a novelty. The interest taken in it here is not small, however, as all connected with the supply of electric light to the public like to know how the service is performed abroad. The same remark applies to any European station, and it is for that reason we give herewith an illustration of the new central station at Berlin, particulars of which have been furnished to *La Lumière Electrique* by Mr. B. Marinovitch.

This Berlin station has been established by the Edison Company, and is situated in Friederich street, close to the famous Unter Den Linden; in other words, at one of the most populous points in the German capital. Mr. Marinovitch compliments the engineer, M. de Miller, on the thoroughness with which the installation has been effected, his comment being, that to fit up and start a station of 300 horse-power in the heart of Berlin, in such a way that no disturbance of any kind is caused to the neighboring proprietors and residents, is no mean feat. Berliners are partial to electric lighting, but they want it without the disagreeable accompaniments of noise, smoke and dirt. The engineers of construction and installation took special pains to prevent the station from being in any sense of the word a nuisance. The foundations for the engines and dynamos were built most solidly, and the result is that the plant may be run to its full capacity without any tremor of the earth being felt beyond the walls of the building. The chimney is carried up to a considerable height above the roof in order that the smoke escaping may not be a cause of complaint, and at the same time by the use of anthracite coal and the best furnaces the actual production of smoke is kept down to the minimum. Means are also adopted to deaden the sound of exhaust steam.

The station is entered from the street through the boiler-room, where three boilers are in position. Two of these are at present in use, one being reserved for emergencies.



EDISON ELECTRIC LIGHTING STATION, BERLIN, GERMANY.

These boilers furnish steam to four horizontal engines—type not named—of 70 horse-power each; and to meet the requirements three of the engines are ordinarily in use. They make 250 revolutions a minute, and are said to be remarkably steady and regular. Each of them drives an Edison dynamo with four-limbed electro-magnets after the "L" type, running at a speed of 1,200 revolutions per minute. It is noted that this style of dynamo is made by Siemens & Halske, and is little known in France, where the Edison Company appear to have pinned their faith definitely and conclusively to the type with two-limbed, thick shortfield magnets, of the kind now used also in this country. Each dynamo is credited with the capacity to energize 500 Edison lamps. The installation embraces three other dynamos to supply current to 24 arc lamps, but no details are given of this portion of it.

Instead of using a voltmeter for each dynamo, as in France, in the best installations, says Mr. Marinovitch, the electrical engineers have but one voltmeter for the station, by which all the machines can in turn be tested. In this manner the differences in electromotive force that would arise from the use of several voltmeters are avoided, and the dynamos are all equalized before they are brought into play. Before a dynamo is allowed to send its current into the supply circuit, it is tested on lamps in the station, and the reading of the voltmeter is taken. As soon as it shows the same electromotive force as the others, it is connected up and feeds the exterior circuit. Thus the lamps are always subject to the same strain, and a greater longevity is insured for them. Other means of the usual nature are used to give warning of trouble on the circuit.

Repulsion between Magnetic Lines of Force.

In a late number of the English *Phil. Mag.* is a letter, on the above subject, from Mr. R. H. M. Bosanquet, in which he states in substance: The idea of a repulsion between magnetic lines of force was derived by Faraday from the repulsion which exists between two magnetic needles placed "side by side with like poles in the same direction." In the deduction of the forces which accompany lines of force, Maxwell reduces them to a tension along the lines of force, combined with a pressure in all directions at right angles to them. Rings magnetized by means of a continuous coil uniformly wound round them present no external magnetic action, though they may be the seat of closed circuits of magnetic lines of force of very great intensity. In this case, we may suppose the ring divided into a number of separate rings, each containing lines of force, and that such rings will be wholly without action on one another. If, then, such similar rings be placed parallel and close to each other, they do not repel each other, as they should do if there existed a repulsion between parallel lines of force. Practically, it is impossible to obtain rings so uniformly forged and wound as to be entirely without external

magnetic action. This usually manifests itself as a slight polarity, which is easily recognized by a compass-needle, the poles being at the extremities of a diameter. In my rings this polarity has always been small, even when the induction in the ring was 10,000 or thereabouts. In the illustration of Faraday, the movement of the system of two parallel needles due to their repulsion leads to a redistribution of the lines of force. The repulsion here observed must depend upon this redistribution. To illustrate: suppose the lines of force to exert their tension-like elastic bands on a mechanical system such that, when yielding to the tension takes place, the needles are separated. In this case, whenever the lines of force are prevented from changing their form, the repulsion at right angles to them must disappear; and this appears to be what actually happens.

Experiments in "Superheating."

In a report to the French Minister of Public Works, by the Central Committee on Steam Engines, of the Academy of Sciences, at Paris, on certain experiments as to the cause of explosion of steam generators attributed to a peculiar state of the water called superheating, the following is given as one means taken and the results secured: In a boiler of normal operation the temperature of the steam is the same as that of the water. If at a given moment, the water becomes superheated (to take that particular state in which it ceases to vaporize), the tension of the steam becomes independent of the temperature of the water, and there must, therefore, occur a difference between the temperature of the two. An endeavor was made to size differences of such a nature, and experiments were planned in which the differences of the temperature of the steam and water of a boiler should register themselves for a long time.

At the Conservatoire des Arts et Metiers, on a cylindrical boiler having four lateral feed-water heaters, a heating surface of 13 square meters, and a grate surface of 27.5 square decimeters, a thermo-electric pile was constructed for suspension in the boiler in such a way that a series of solder-rings should dip into water, while others of equal number should remain in the steam. This pile, 45 centimeters in length, consisted of 15 iron wires and 15 German silver ones, 1.5 millimeters in diameter, soldered successively by their extremities arranged according to the generatrices of a boxwood cylinder, 40 millimeters in diameter, having an aperture running through it lengthwise for the passage of the copper wire by which the pile was suspended vertically from the self-closing cover of the man-hole of the boiler.

The ends of contrary polarity, which remained free, were connected with a galvanometer needle, whose deflections were registered every quarter of an hour upon a sheet of paper by means of a puncture made by a vertical point fixed to the needle's extremity. Each positive experiment included the registering, every twenty-four hours, of the position of the galvanometer needle, before firing up and until the boiler was under pressure, at the time the engine was set running, and while the latter was operating under nearly a constant pressure, and finally during the period of cooling, up to the next day or day after. Then the paper was changed in order to obtain a new diagram corresponding to the firing up again, before or after a new feed, until the pressure had risen to the normal one of five atmospheres, and had permitted the engine to run regularly. No notable deviation was exhibited in the position of the galvanometer needle during all these alterations, or during the whole duration of the observations, which were greatly prolonged. It resulted from an examination of the diagrams that the temperature of the steam pole was in general not quite so high; but the difference was always below 2°. This is explained by the proximity of the sides of the boiler, the temperature of which was naturally lower than that of the steam, and which radiated against the steam pole.

During the night of August 26–27, the galvanometer needle became strongly disturbed, as shown by the tracings. What was the cause of it they do not know; but, in any event, the form of the tracing does not permit it to be attributed to superheating, seeing that the movements occurred between half-past one and six o'clock in the morning, that is to say, during the period of cooling. Further, the diagram shows that the deflections of the needle occurred suddenly and disappeared slowly, while the contrary would have taken place had superheating been the cause of the movements. It is thus established by direct experiment, that no appreciable difference is shown between the temperature of the water and that of the steam during any of the periods comprised in the observations; either during the running or during firing up or cooling.

Lights in a Lunatic Asylum.—The plant installed by the N. Y. Consolidated Electric Light Co. at the Eastern Lunatic Asylum, Williamsburg, Va., comprises one 50 h. p. Westinghouse engine and two 350-light Sawyer-Man dynamos. There are 400 sixteen candle-power lamps in place, and of these 350 are burned about 15 hours per day. All the 350 are fed by one machine. Dr. Moncure, the superintendent of the asylum, expresses himself as being perfectly satisfied with the operation of the entire plant. It can be easily understood that the healthy, bright and cheerful electric lamps have a beneficial effect on the patients.

Some American Galvanometers at the Philadelphia Exhibition.

Among the instruments shown at the late exhibition in Philadelphia were two galvanometers, the beauty of design, finish and workmanship of which entitle them to special mention. One was a reflecting galvanometer of the tripod pattern, introducing some improvements, and the other a sine and tangent combined. Both were made and exhibited by the Electric Mfg. Co., of Troy, N. Y., and are shown in the accompanying cuts.

In the first-mentioned instrument the ring which carries the front coil is attached by a hinge and a spring catch to the frame carrying the coils. This frame is held rigidly to the back of the case by four posts; the back of the case

Fig. 1.

being also hung upon a hinge and when closed against the case is held in a position by a spring catch.

The coils are slipped into the rings which hold them, and may be replaced by an extra set of coils of higher or lower resistance.

When it is desired to get at the suspension or change the coils or alter the astatic-system, all that is necessary is to withdraw the spring-catch by pressing upon the knob at the side of the case and swing the back out on its hinge. The front coil may then be dropped down out of the way. Any one who has tried to replace suspensions in this class of galvanometers will appreciate the improvements introduced in this instrument; and we are told that all four styles of this class of galvanometers manufactured by this company have similar improvements introduced.

One of the handsomest instruments at the Exhibition was their sine and tangent galvanometer. The six-inch ring carries two coils of the resistance of about one and twelve ohms respectively, and this ring is held perpendicularly to the needle-box plate by four brass L pieces. By

Fig. 2.

means of two knobs, this plate may be turned around upon an outer ring on which it rests. This outer ring stands on three legs provided with leveling screws. The upper surface of the outer ring is silver plated and divided into degrees rendering the instrument applicable to being used as a sine galvanometer. The diamond-shaped steel needle is supported by a fine jewel upon an adjustable point, so that the centre of the needle may be made to coincide with the centre of the coils.

Parallel to the shorter axis of the needle is fastened an aluminium pointer which moves over the silver-plated needle-box dial, and a button at the side allows the needle to be lifted off the point and held against the glass cover of the needle-box when the instrument is not in use.

The workmanship and design of both these instruments are all that could be desired.

The Efficiency of Lighting Systems.

A great deal has been said and written as to the relative cost of the rival systems of gas and electric lighting by their respective advocates, who are each careful to show in strong relief the merits and advantages of the particular methods. This being so it may be interesting to take a neutral position and endeavor to ascertain upon what basis each system stands with regard to their relative efficiencies as this is a point that has been generally neglected, it may be because they are each of them much lower then is generally supposed. As each of the systems begins with the combustion of coal or of its products, we will take the example of a ton of coal and ascertain what result in light may be obtained by the two methods. In the results for incandescent electric lighting we shall employ figures which have been obtained during a long series of experiments by the writer, particulars of the experiments being given as we proceed. From the same source he has also a series of photometric measures of known quantities of gas burnt at ordinary pressures through the classes of burners most commonly in use. The gas measures, however, we shall reject and accept the values officially given. The reason is that although we are perfectly satisfied with the rejected measures it may be objected that as they show little more than one-half the official value there is room for contention if they are used for comparison.

The distillation of one ton of coal will give 9,500 cubic feet of gas having a nominal illuminating power of 16 candles, besides more or less valuable bye-products, such as tar and coke. This gas burnt through suitable burners will give a light equal to that of a standard candle for 20,400 hours, or to that of 20,400 candles for one hour, which we will call 20,400 candle-hours.

The same weight of coal will give in a good modern engine 1,200 horse-power hours available for driving a dynamo or dynamos. With arc lamps, using Siemens' carbons 18 mm. in diameter with a difference of potential of 42.75 volts, a current of 18 to 25 ampères and allowing an efficiency of 80 per cent. for the dynamos we could obtain 5,263,000 candle-hours (*Gordon's Electric Lighting*, p. 107), or 258 times as much as is given by the equivalent gas. We hasten to concede that this is an excessive value for the arc light, and, with the observation that it has undoubtedly been obtained, we will add the average value of a large number of different readings with different carbons and strengths of current taken from the same authority. This gives us 2,825,520 candle-hours, or 138 times as much light. To put the matter in another aspect, we may use the 9,500 cubic feet of gas to drive a gas engine, and thus obtain 380 available horse-power hours for driving dynamos. With the best value of the arc this would give 1,578,900 candle-hours, and with the average value 847,656, or 77.4 and 41.5 times as much, respectively, as could be obtained by using the same gas in suitable burners for direct illumination. As we know very accurately the efficiency of both the gas engine and dynamo, these figures give us an opportunity of finding the comparative efficiency of gas lighting. The loss arising in the dynamo is already allowed for; the loss in the gas engine is 55 per cent. Taking, then, the best value of arc lighting we have an efficiency for the gas burner of 0.6 per cent. This result compares very closely with the value determined or approximated on another method by the late Sir William Siemens, who gave it as "less than one per cent." The comparative efficiency with the average of several arc lights is about 1.1 per cent. This value is nothing to be proud of after 60 years' experience with gas lighting, and leaves room for very material improvement. It may be objected that the value we have given to the dynamo (80 per cent.) is excessive, and that such a return was not obtained in the trials referred to. Mr. Sprague's experiments show that in a modern machine the value should be 85 per cent. Experiments with older machines show values from 65 to 80 per cent., and for the particular purpose we are justified in taking a value that could certainly be secured.

Notwithstanding the high efficiency of the arc light, it is unsuitable for general interior illumination, for which the incandescent lamp alone is applicable. Incandescent lamps differ in their efficiency to a remarkable degree. Taking three of the best-known types of such lamps and denoting them by the letters A, B and C, it was found that the rates of work required to maintain them at their nominal brilliancy were A 4.13, B 2.52 and C 1.81 foot-pounds per second per candle. We have preferred to reduce the rates to the ordinary mechanical units, so as to facilitate comparison and to avoid the use of the unfamiliar electric units. The measures were in each case taken with different groups of ten lamps each, a large number of each kind being employed in order to obtain a satisfactory average working result, which cannot so well be secured in measuring only one lamp at a time. As the "C" lamps are said by competent authorities to be equal, or about equal, in durability and other respects to the "A" and "B" lamps, we will found our comparison upon them.

According to the figures given, the "C" lamps give 303.8 candles per electrical horse-power, or 243 candles per available horse-power in the engine. The number of horse-power hours available from one ton of coals is 1,120, which gives a total of 272,160 candle hours as against 20,400 from the direct burning of the gas obtained from

the same quantity of coals, and against 5,263,000 with the best arc light, or 2,825,520 with average arc lights. Instituting the comparison of the result obtainable by burning the 9,500 cubic feet of gas in a gas-engine, we get 91,140 candle hours for the roundabout method of using the gas against 20,400 for the "direct" method—in other words, we may obtain 4.5 times more light by burning the gas in a gas-engine than is obtainable by burning it in an argand burner, even when using the highly inefficient incandescent lamp. Taking the efficiency of gas as 1 per cent., the efficiency of the "C" incandescent lamp is, according to the figures previously given, 13.3 per cent., which decidedly leaves very ample room for improvement; but, considering that the incandescent system is about three years old and the gas system sixty, there appear to be reasonable grounds for the congratulations which have been bestowed upon the pioneers of electricity by their friends.

We have given the relative efficiencies of three types of incandescent lamps, and shown that they vary at their rated power as 4.13, 2.52, and 1.81. But it is objected by the makers of the A and B lamps that the C lamp is rated too high, while A takes the same objection to B. With the object of putting this matter at rest so far as efficiency was concerned, a large number of experiments were made with groups of ten lamps each of the three types. Several groups of each type were employed, and members of the groups were continually interchanged, so that no two experiments were made on a group consisting of the same individual lamps. The results were very uniform for each type, and may be taken as a safe practical average. First, each group was supplied with a current capable of yielding one and a half times the rated candle-power; second, with a current giving the rated power; and third, with a current giving half the power. An additional set of experiments were made with the A lamps at double their power, in order to meet the suggestion that the A lamps were rated at half the incandescence of the C lamps. The results are given below, the value being in foot-pounds per candle-power:

		A.	B.	C.
Rated candle-power	× 2.0	2.32	....	....
" "	× 1.5	3.25	1.61	1.4
" "	× 1.0	4.13	2.52	1.81
" "	× 0.5	5.53	4.57	2.76

From these figures it will be seen that the relative efficiencies taken at any reasonable rating are in order of merit C, B, A. That there is not unanimity in the method of rating the above figures will make evident when it is attempted to formulate a law from them.

The question of rating the lamps involves also the question of durability; but this is essentially a matter of cost which we purposely exclude, because of its complication, from this article. It may be permitted us to say, nevertheless, that if a lamp is rated at a high power the gas globe soon becomes clouded, and its efficiency thereby diminished, and, further, that its duration is greatly reduced. The element of clouding is one that is generally overlooked by writers on the question, but it certainly deserves attention.

Those of our readers who desire to convert our foot-pound units into volt-ampères or "watts" may do so by using the constants 1.355 as a multiplier. This gives for the C lamps at their rated power 2.45 volt-ampères per candle; 304 candles per electrical horse-power, and about 243 candles per horse-power available from the motor as before stated.—*Mechanical World.*

Overhead Telegraph Wire.—III.

BY WM. MAVER, JR.

I shall now proceed to describe the various processes through which iron and copper pass, in their transformation from pig-iron and copper ingots, into telegraph wire, and also the methods employed in the factories for testing the wire for tensile strength, elongation, conductivity and gauge, reserving for the conclusion of the article some general remarks on the sources of the trouble met with in the erection of copper wires on the poles and some of the means which have been adopted to obviate the same.

Referring first to iron wire only. The iron used for telegraph wire is mainly Swedish iron. It is brought into this country in the shape of pig-iron. The first process to which the iron is subjected consists either of puddling or of "sinking" in a charcoal fire in a Lancashire forge, by which means it is converted into wrought-iron. The latter process produces what is called a charcoal iron, and the former a puddled iron. The charcoal fire produces an iron which is considered much superior to the puddled iron.

When the iron has been sufficiently long in either of the foregoing furnaces it is taken out and hammered under a steam trip-hammer, by means of which all impurities or imperfectly melted portions of the iron and cinders are forced out—a very necessary operation, as, should any impurities be allowed to remain in the iron, it might be the cause of much trouble in the later processes.

When the iron has undergone the above operation, it is technically termed a "bloom."

The "bloom" is then reheated and rolled into a bar, or, as it is called, a "billet." It is again heated and then rolled into rods, after which the iron is cleansed by immersion in acids, and then coated. The wire rods are then drawn cold through one die after another in the manner already explained to the size desired, during the process of which the iron is annealed.

After each annealing the wire is again coated, for of course in the process of annealing the previous coating is destroyed.

The effect and intent of annealing is to bring the iron wire to the proper degree of ductility.

The process of annealing is conducted in the following manner: The coils of wire are placed on the iron pillar *P*, in Fig. 3. The pillar stands about 14 feet high. A derrick lifts the pillar and the wires on it and lowers it into the oven *F*, only the roof of which is seen above the floor, after which the cover is closed and only a small opening, *O*, left. At the bottom of this oven there is a furnace which keeps the iron at a certain required heat. When the wire has assumed a peculiar red color, which the workman in charge observes through the opening *O*, the cover is removed and the derrick raises the pillar and wire out of the oven. This process of annealing requires about 24 hours.

At this stage of the manufacture each coil is carefully inspected to discover all unsound and imperfect wire.

The wire is then again annealed, and cleansed and galvanized in quick succession, by means of the arrangement which Fig. 4 will illustrate, with the help of a very short explanation.

I should say in advance that the process of galvanizing consists of passing the wire through a bath of molten zinc. The term galvanizing was derived at the time when iron was first given a zinc coating by electrolytic action, an expensive method of attaining this object, which was speedily abandoned when it was discovered that the same result could be obtained more economically by simply submerging the iron in molten zinc.

The object of galvanizing iron wire is to protect it from the oxygen of the air (or, in other words, to prevent the iron from rusting), which it does in the following manner:

The zinc covering, having a greater affinity for oxygen than for iron, combines with the oxygen of the air, forming an oxide of zinc, which is the chemical term for a combination of oxygen and zinc in certain proportions. The oxide of zinc remains on the wire and thus protects it.

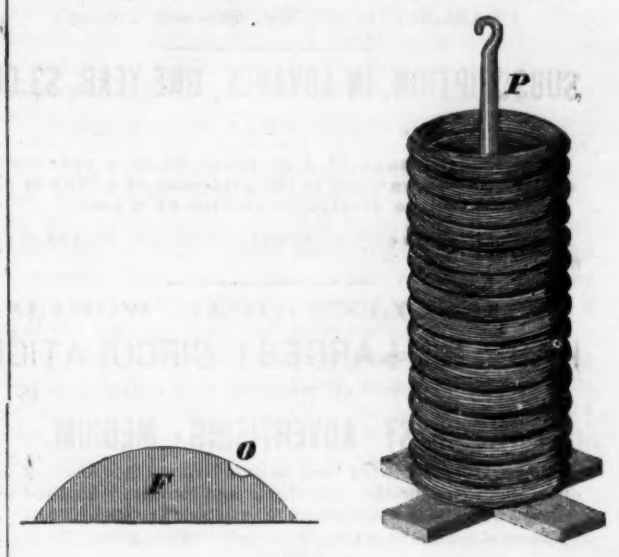


FIG. 3.

In manufacturing cities, however, where much coal is consumed, and consequently much sulphuric acid gas is liberated, zinc does not long constitute a cover for the iron, as the sulphuric acid and the oxide of zinc now combine and form sulphate of zinc, which, being soluble in water, is soon washed off by rains, leaving the iron to rust.

In Fig. 4, *B* is an oven containing longitudinal tubes of fire-brick, which are kept at a white heat by a furnace underneath. In the course of passing through these tubes, the wire becomes red hot. Each wire, as it comes out of *B*, falls of its own weight into the basin *M*, containing a solution of muriatic acid, which thoroughly cleanses the wire of all grease, etc., and prepares it for galvanizing. After passing through the bath *M*, the wire next slides into the bath of molten zinc *Z*, and comes out of it galvanized; in other words, zinc-plated.

Each wire then passes over the gearing *G*, and thence is automatically rewound into coils on the drums *D D D*. In passing through these three operations about 20 seconds are consumed.

The next step is to thoroughly inspect the galvanizing and to reject all the wire not well and smoothly galvanized. Such rejected wire is afterwards only available for fence wire or something similar.

After this work has been completed, samples are taken from among the coils for the purpose of making mechanical and electrical tests to see that the wire, as manufactured, comes up to the standard required by the specifications. These tests are made chiefly to ascertain the tensile strength and conductivity of the wire.

Before describing the methods of making these tests, it is only necessary to say that the process of producing copper wire from the billet, or ingot, is, with the exception of galvanizing, annealing and some other minor points, practically the same as for iron.

As I have already said, the various manufacturers of hard-drawn copper wire consider their methods of preparing hard-drawn copper wire trade secrets, and consequently it cannot be described in detail at present.

The usual length of the piece of wire, either iron or copper, taken to test for tensile strength, is ten inches. It would, of course, be a surer test if a vastly longer piece of wire could be tested, as there would be so many more opportunities to detect bad pieces in the longer space; but to test so long a piece would be a cumbersome and in many cases an impracticable work.

The instruments necessary in testing for tensile strength comprise a set of large scales and one or two other contrivances seen in Fig. 5.

The wire *W* is placed between two jaws, which are arranged so that the stronger the pull the tighter becomes their hold. It is necessary that the surface of the jaws should be very smooth to avoid cutting the wire. *S* is a screw which is revolved by a worm screw, the shaft of the latter being in connection with the belt *B*. The screw can be made to revolve quickly or slowly by means of the lever *H*. As the screw is revolved, the jaws begin to pull on the wire, which conduces to elevate the long end or beam of the scales, which is brought to a balance by shoving along the weight *T*, precisely as if any substance were being weighed, by suspension from the upper jaw *J*.

The point at which the wire breaks is called its tensile strength.

Tensile strength machines are made in various forms; some of them are arranged so that the substance to be tested is placed horizontally, and one of the latter that I have seen is capable of testing anything, from a piece of cord having a strength of 10 pounds to a bar of iron having a tensile strength of 200,000 pounds.

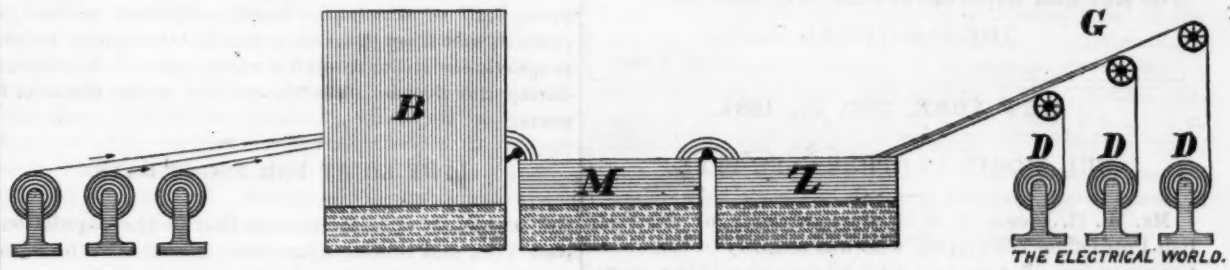


FIG. 4.

The amount of elongation is ascertained in the following manner: In the first place, when the wire is about to be tested for tensile strength, it is carefully marked by a pencil at the jaws. After the wire has been broken the fractured ends are placed together and the length of the wire between the pencil marks is carefully measured, from which measurement the percentage of elongation is calculated.

Iron wire is generally expected to stand an elongation of 18 per cent. without breaking, after having been galvanized.

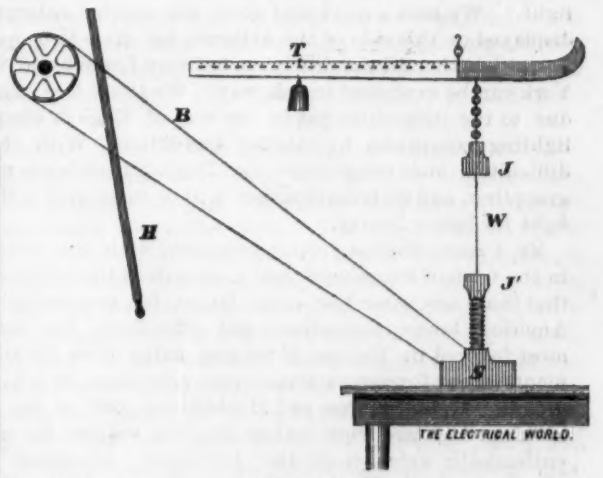


FIG. 5.

Specimens of the wire are also tested for ductility by twisting, for while tensile strength is of great value, it is also necessary that the wire should be prepared to stand the twists and kinks to which it may may be subjected in the course of erection. The tests for ductility are commonly made as follows: One end of the piece of wire to be tested is placed firmly in a vise, a streak of ink is then drawn straight along the surface of the wire. The loose end of it is then twisted until the wire breaks. The number of spiral rings of ink will then indicate the number of twists which it has stood.

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OUR LIGHTS AS OTHERS SEE THEM.

Mr. W. H. Preece, F. R. S., the electrician of the English Post Office Telegraphs, who was recently in this country renewing old American friendships and making many new ones, has laid before the English Society of Arts the results of his observations here in regard to electric lighting. We give his interesting paper in full on another page. To most of us the facts are familiar, but there is a great advantage in having them collated and commented upon by one of Mr. Preece's eminent position and practical turn of mind. We understand that the paper given does not by any means exhaust his note books, and our readers may look, therefore, for further installments.

The difference between the old world and the new in the adoption of new things is strikingly brought out in the opening remarks: "On the evening of October 21, I drove from the Windsor Hotel, New York, to the Cunard wharf, a distance of about four miles, through streets entirely lighted by electricity. On October 30, I drove from Euston to Waterloo (two railway depots in London about the same distance apart), without seeing a single electric light." We hear a good deal about the greater enterprise displayed on this side of the Atlantic, but it is to be questioned whether all the difference between London and New York can be explained in this way. We think it is largely due to the difficulties put in the way of English electric lighting companies by existing legislation. With those difficulties and restrictions our English friends are now grappling, and we trust that they will be successful in their fight for larger liberty.

Mr. Preece was not greatly impressed with the novelty in the form of lamps used, and even gained the impression that there are some European lamps far surpassing the American lamps in steadiness and efficiency. The lamps most favored in Europe, if we may judge from the statements in our foreign exchanges, are American, such as the Brush, Weston, Edison and Hochhausen, and at the Exhibition we heard from various English visitors the most enthusiastic eulogies on the brilliancy, steadiness and economy of the Thomson-Houston lights. If the European lights far surpass ours in various respects, it is somewhat remarkable that ours should be so greatly in demand all over Europe, to say nothing of Africa and the Orient. Owing to the general use of the leading American lights abroad, a foreign electrician would not be likely to see much that was unfamiliar on his arrival and investigation here, except in minor details.

The system of street lighting by arc lamps on towers does not appear to have gained Mr. Preece's favor. He describes, however, only the experiment in Cleveland. We have heard that installation highly commended, and believe it compares well with the lighting in Union and Madison Squares in this city. The tower system is certainly popular here and gains ground, but would hardly be on the increase if the general results were as summed up by Mr. Preece in the remark "the effect was very poor." It may be a matter of taste, but personally we know of few outdoor sights more beautiful than Madison or Union Square in summer time, with the rays from the tall electric tower shining down at night on the masses of foliage and the throngs of promenaders. Mr. Preece mentions the fine effect produced in Washington by lofty lighting.

As usual, the poles with which the American streets are so profusely ornamented, provoke the visitor to scorn, and Mr. Preece speaks of the "unsightly posts." Still it is mainly to the use of the much-berated poles that we owe the use of nearly 100,000 arc lamps throughout the country. During the next ten years many of the poles will disappear, but the lights, having gained a strong hold and become generally known through the ease with which they were introduced, will continue to multiply, provided large incandescent lamps are not operated so cheaply hereafter as to supplant them in some places.

The prices charged for electric lights here impress Mr. Preece, who takes the opportunity, in view of some of the figures, to repeat and emphasize his opinion that "at the present day we can only regard the electric light as a luxury, and we must pay for it as a luxury." But we think that the prices will compare favorably with the American rates for gas, say about $2 to $2.50 per 1000 feet (eight shilling to ten shillings) although they may look high contrasted with English gas rates of from $1 to $1.50 per 1,000, (four shillings to six shillings). We think that if as much electric lighting as gas were supplied in any city of large population it would be found that the former was quite as cheap as the latter. If the 90,000 arc lamps in use all over the United States were 900,000 they could certainly be made and run at a cost much below the present rates. The same argument applies to incandescent lighting, and Mr. Preece himself quotes figures showing that at the figure of gas rates, incandescent systems can be and are now worked here with success.

Any one who inclines to the opinion that electric lighting is "played out," would do well to read Mr. Preece's able and well-digested paper. It presents briefly and clearly the progress made in this country during only five years, half of which time business has been seriously depressed; and from progress so marked it requires no great prophetic insight to foretell a vastly greater development during the decade 1885–'95, or even within the next five years.

THE LIGHT FOR FOGGY DAYS.

It is thought by some persons that as the population of New York and Brooklyn increases, as well as of the numerous suburbs in which merchants, clerks and laborers make their homes, there will also be a marked increase in the number, density and duration of the fogs in this region. Last winter the fogs were very thick and heavy, and judging from the early arrival of fogs this season, New York will soon be able to concoct a fog before which even the "London particular" would vanish in shame and humiliation. Whether the product of superior fogs is a thing to be proud of or not, we will not discuss or determine, but we note that the peculiar state of our atmosphere during the winter involves important questions of office illumination. This week a very large number of the offices in New York have been lighted up in the daytime, and the superiority of electric lamps over oil and gas has been, in our opinion, very decided. The appearance of the fine new buildings into which electricity has been introduced has been very cheerful, and the heavy outer air was not, on entering them, supercharged with the hurtful exhalations and deposits from oil lamps or gas jets. If many more fogs visit the city, the electric lighting companies will have an excellent text to preach from.

WAITING FOR THE TELEPHONE.

The new English Postmaster General has had a reminder of one of the problems to be solved, in a visit from a deputation of gentlemen representing and bringing memorials from merchants and traders engaged in business at Plymouth, Stonehouse and Devonport. They pointed out that the present exchange at Plymouth, one of the busiest seaports of Europe, with a population of 100,000, has the ridiculously small number of only forty-two subscribers. This little fact is damning in itself, so far as governmental management of the telephone is concerned in England. What would we think in this country if any of our cities of the same size as Plymouth had no more than forty-two subscribers? The memorialists want better facilities, and ask that the three places named shall be regarded as one town for telephonic purposes. All that the Postmaster General could say in return was that no doubt the department would send some one to make inquiries, and that he would himself give the matter attention. This is not very encouraging, but as so many concessions have been made of late, there may be reason to hope that the good folks of Plymouth will soon have as many telephones in use as they want.

LIBERAL PATRONAGE OF THE CABLE.

Some little while ago, the New York *Times*, by means of Mr. Frederic, its London correspondent, performed a very creditable journalistic feat in obtaining from that gentleman, who bravely visited the stricken city for the purpose, long cable dispatches describing the condition of Marseilles during the epidemic of cholera. The dispatches were most welcome, and evinced a keen appreciation of what the public wanted in the way of news. Now the *Times* has again displayed great enterprise, without regard to cost, in obtaining by cable from Madrid a draft of the proposed Spanish treaty. The dispatch was all in the Spanish language, but it was immediately translated here and was soon in the hands of the community. Naturally some mistakes in transmission and translation were made, but as a whole the feat was one of which any journal might be proud. The actual cost of cabling, aside from other expenses, was over $4,000. The sum is a large one, but it was judiciously expended. We may look for more exploits in the same line. Cable proprietors, here and abroad, will be the last to frown on such spirited collection of news.

REVIEWS OF NEW BOOKS.

ILLUSTRATIONS AND DESCRIPTIONS OF TELEGRAPHIC APPARATUS. By Astley C. Terry and William Finn. Buffalo, N. Y. Astley C. Terry, 1884. $2.

As the preface of this work informs us, its chief object is "to bring within the reach of all telegraphers a book illustrative and descriptive of the principal telegraphic apparatus in practical use upon the lines of the different telegraph companies at the present day," and in this object the authors certainly have been successful to no inconsiderable degree.

To a certain extent, both outwardly and inwardly, this book resembles its predecessor in the same general line of illustrations and descriptions, namely, Davis & Rae's "Hand-book of Electrical Diagrams and Connections," but it must be said that it possesses some advantages over the latter, not only in point of illustrations and in the method of their compilation, but also in the selection and the novelty of the telegraphic apparatus described.

The diagrams, of which there are thirty in the book, have evidently been designed, and successfully, too, with a distinct view to perspicuity, and in this respect they are in marked and favorable contrast with some of the older works on similar topics.

The descriptive portion of the book, while probably not so complete as the average telegrapher will be likely to require, has been well treated in the limited space at disposal.

The systems which have received the most attention at the hands of the authors are the Stearns and the polar duplexes, the quadruplex, and the Wheatstone automatic system; and these diagrams and descriptions will undoubtedly be of much value to the telegrapher seeking knowledge on these particular subjects.

The diagrams illustrating the duplex and quadruplex apparatus in detail, plates XVIII. and XIX., are worthy of especial note as giving at a glance information concerning these instruments not frequently furnished in text books.

The book is remarkably clear of mistakes, the nearest approach to an error, so far as we have observed, being in the caption of plate XIV., namely, "Polar duplex, with battery at one station only." This duplex is really no more a polar duplex than it is a so-called Stearns duplex. In other words, the duplex referred to is a combination of both of those systems.

In addition to the foregoing, the work illustrates clearly and precisely, among other subjects, the double-jack switch-board; peg switch at intermediate station; relay arranged to work sounder and register; combination locals; the Edison button repeater; Neilson's shunt repeater; the Wheatstone bridge or balance; the tangent galvanometer; ordinary circuit testing; the universal gold and stock system, and Gray's harmonic telegraph.

Altogether the work is one which reflects much credit on the authors and they are to be congratulated upon the very neat appearance which it presents.

The book is well bound in cloth, and it is printed in well defined type, on supercalendered paper, and it will, in our opinion, prove valuable, not only to the student as a source of new information, but also to the experienced telegrapher as a handy book of reference.

A Copper Pool Broken.

The Lake Superior copper mining companies, early in the present year, joined in agreements to regulate prices and prevent competition, the pooling contracts running into 1885. But certain companies discovered markets for their product at extra prices or for extra sales, and they proceeded to fill orders. Then there was trouble; the matter was taken into the courts, and the Lake Superior copper ring was "smashed," and nobody is apparently the least the worse therefor, but all consumers of copper are benefited thereby, though the market price is little affected. Through the supply furnished from the mines of Montana and Arizona, the price of the metal, two years ago 18 cents per pound, is now reduced to 12 cents, with plenty of the article to be had.

Electric Lighting in America.*

BY W. H. PREECE, F. R. S.

Electric lighting is flourishing in America much more than at home. There are probably 90,000 arc lamps alight every night in the States, and there are many central stations working regularly, both with arc and with glow lamps. I know nothing more dismal than to be transplanted from the brilliantly illuminated avenues of New York to the dull and dark streets of London. This has happened to me very recently. On the evening of October 21, I drove from the Windsor Hotel, New York, to the Cunard wharf, a distance of about four miles, through streets entirely lighted by electricity. On October 30, I drove from Euston to Waterloo without seeing a single electric light, having been on the ocean during the intervening period. I visited Montreal, Philadelphia, Buffalo, Cleveland, Chicago, St. Louis, Indianapolis, Boston, and New York; finding in each city the principal streets and warehouses, as well as stores and places of public resort, lighted by arc lamps. After so much brilliance in these cities, the return to dull gas has a most depressing influence. It is with arc lighting that the greatest advances have been made in the States. One manufacturer alone told me that he was turning out 800,000 carbons for arc lamps per month, and another said that his output of plant was fifty arc lamps and three dynamos per day; and while I was present at a third factory, an order was received for an electric lighting plant of 330 arc lamps, requiring fourteen 24-light dynamo machines intended for an installation to light up a driving park in the environs of Chicago. As an instance of the growth of electric lighting, I may mention that in Chicago the number of arc lamps installed has doubled, viz., from 1,000 to 2,000, during the past twelve months, and the number increases daily. More than one electric light company pays dividends to its shareholders, and all of the manufacturers as well as the lighting companies seem to be full of work. The principal systems in use are, for arc lamps—the Brush, the Weston, the Thomson-Houston; but there are other arc systems, not so well known on this side of the Atlantic, such as the Hochhausen, the Van Depoele, the Western Electric, the Fuller, the Sperry, etc.; for glow lamps—the Edison, and the Weston. I will describe briefly the systems I saw in use, dividing them into (1) arc systems and (2) incandescent systems.

I.—ARC SYSTEMS.

The Brush System is so well known that it scarcely needs any reference, excepting to point out that a very considerable improvement has recently been made in the dynamo machine, which has very largely increased its capacity and output. The new Brush armature consists of layers of thin sheet iron, insulated from each other. By this arrangement induced currents—improperly called "Foucault" currents, for they were fully described by Joule as far back as 1843—which produce heat, and thereby diminish the efficiency of the machine, are prevented from being formed; and, further, should heat arise through excess of current, thorough ventilation is effected to carry it away by convection. Brush dynamos, which previously, with the old armature, lighted sixteen and forty lamps respectively, now, with the new armature, excite thirty lamps and sixty-five lamps; so that it will be seen that the improvement is very considerable.

The Weston System.—This system, looked at from a mechanical point of view, strikes one as being probably the best in use in the States. The machine itself is of the Siemens form, but the armature is made up of discs, stamped out of thin sheet-iron and separated from each other by washers. By this method, first suggested by Joule in 1843, those disturbing induced currents are entirely checked, and thereby the undue heating of the armature prevented. Mr. Weston appears to have been the first to have practically carried out this very sensible idea, and it is being rapidly adopted by other makers of dynamo machines. I have mentioned that Mr. Brush has followed out the same idea. The commutator in the Weston machine differs from most American commutators, in that it has no less than 140 segments, which tend to prevent "sparking," a very disturbing element in the action of dynamos. In fact, the absence of sparks is one of the striking features of this machine. There are standard Weston machines for working arc lamps, and also for working glow lamps. Both kinds are shunt wound, the former being supplied with a most sensitive and extremely ingenious regulator which adjusts the strength of the shunt current or field magnets, so as to maintain the current in the main line constant. The 200-light Weston dynamo for glow lamps is peculiar in the extreme lowness of the resistance of the armature, which is only .0011 ohm, while the resistance of the shunt is 24 ohms, thus having a ratio between them of 1 to 2,182. The result of this lowness of resistance is such that a resistance of the armature may be neglected, and therefore the dynamo becomes self-regulating. I saw 199 lamps out of 200 suddenly extinguished, without producing any apparent change in the incandescence of the one glow lamp left. The electromotive force of this machine is seventy volts when rotated at 1,000 revolutions per minute. The arc lamps of the Weston type do not call for special notice, excepting to record the remarkable steadiness of their burning. They are fed on the differential principle, but they owe their steadiness and good working to the perfection of workmanship and the mechanical finish of their parts. The beautiful suspension bridge at Brooklyn is lighted entirely by eighty-two Weston lamps. This is done by the bridge trustees themselves, and the view of this bridge at night from Staten Island and from the magnificent harbor of New York is one of the prettiest optical effects I have ever seen. New York harbor will soon be so brilliantly illuminated by electric lights that one of the enterprising ferry companies contemplates having nightly excursions, which it is intended to advertise as the "Theatre of New York Harbor by Electric Light; price of admission, 10 cents." Local companies using the Weston arc system are successfully operating central stations, supplying a large number of lights for rental at Boston, Springfield, Manchester; Providence, Rhode Island; Newport, Rhode Island; New York City, Rochester, Elmira and Glen Falls, New York; Newark, Cape May, Atlantic City, etc.

The Thomson-Houston System.—This system is unknown at present in England. It contains some considerable and ingenious novelties. The armature is spherical, and is almost entirely encased by the field-magnets; the magnetic field thereby becomes inclosed, and is very intense. The dynamo is series wound. The commutator consists of only three sections, and there are only two pairs of brushes. It has an automatic governor, which adjusts the lead of the brushes to positions of varying electromotive force as the work itself varies, so that, however much the number of lamps may change, the current remains steady. It has a peculiar air-blast device, to prevent undue sparking at the brushes; strong currents or puffs of air prevent the formation of those lines of minute conducting particles which bridge across the air spaces at the commutator, and whose presence forms one cause of so-called "flashing," and they blow out the sparks which would form at the brushes. The arrangement also admits of the free oiling of the commutator, a point of very considerable importance at a place where there is so much wear, and a peculiarity of this dynamo. The ordinary size Thomson-Houston dynamo lights up twenty-five arc lamps, and it has 225 lbs. of copper on the armature, and 700 lbs. on the field magnet. When rotated at the ordinary speed of about 900 revolutions per minute, it acquires an electromotive force of 1,200 volts, and generates a current of 9.8 ampères in the lamp circuit. The lamps have an average resistance of 4.5 ohms, and the electromotive force that each lamp takes is 45 volts. A 25-lamp circuit absorbs 23.25 horse-power. The commercial efficiency of this machine is therefore 80 per cent. Frequently as many as seven of these dynamos are joined up in series. An interesting example of lighting is that of a new swing bridge crossing the river at Rush, near Chicago, which is moved with promptitude and lighted with brilliance by steam engines fixed in the centre of the bridge. All connection with the shore is cut off, but the whole thing works with great steadiness, although a heavy traffic, four abreast, is maintained all day long.

The Hochhausen System.—This is slightly known in England, from its employment in the recent International Health Exhibition to light up the tall mast in the centre of the gardens, but it has scarcely received the attention that it merits. It is doing a large business, but I did not visit any places worked by it.

Central Stations.—I visited the central station of the Thomson-Houston Company at Montreal. It was opened on the 14th March last, and Sept. 3, when I was there, there were 164 arc lamps alight in the public streets and shops of the town. The wires through the town were all of copper, principally No. 6 gauge, covered with cotton and asbestos, and were in all cases carried through the streets on unsightly posts. The rate charged is 50 cents per night, the lamps being lighted from dark to midnight; this means over £35 per lamp per annum. I visited other central stations worked on this system, and I learned that it was decided to light up the public streets of Ottawa entirely by the Thomson-Houston system. In that case the power will be obtained from the celebrated Chaudiére Falls, that add so much picturesqueness to the position of Ottawa and wealth of its inhabitants, for it is the great source of power used to carry on the timber trade of the place. Another central station that I inspected was that of the Brush system, at Philadelphia; there, 1,200 horse-power was employed in supplying electricity for nearly 1,000 lamps. At Montreal, open wires are used, supplying 25 circuits, some of which are four miles long. The charge for each lamp is $25 per month, which is equal to £60 per lamp per annum. The Brush people have also two central stations at Boston, lighting up 816 arc lamps; in fact few towns of any consequence in the States do not possess central stations worked by the Brush Company. There are, probably 25,000 Brush arc lamps in use in the States. At Chicago there are now over 2,000 arc lamps going, and they are increasing in number every day. The Lincoln Park has all its drives lighted by arc lamps, with very great effect, especially on the unique drive skirting the shore of Lake Michigan. There are several central stations belonging to various companies in Chicago, viz., the Western Electric, the Van Depoele, the Fuller, and the Sperry Company; while the Hochhausen system is about to be started with a central station for several hundred lamps. I did not observe any particular novelty in the form of lamps used, and the impression I gained was that there were some European lamps that far surpassed the American ones in steadiness and efficacy.

Street Lighting.—I did not see in the States one single instance of street lighting by glow lamp. In every case arc lamps were used for this purpose, and they were usually fixed on much taller posts than we are accustomed to see in England, arranged in zigzag fashion along the streets, at a distance from each other of about fifty yards. Although the effect of this street lighting by arc lamps was brilliant, it was by no means perfect, and no effort seems to have been made to distribute the light uniformly, as has been done in England by Mr. Trotter; and, in fact, the question does not seem to have been attacked at all from a scientific point of view; the commercial spirit alone appears to have been exercised in developing this enterprise. An interesting experiment has been tried in Cleveland, where eight Brush lamps are fixed upon the tops of four iron masts, each about 250 ft. high, fixed in prominent positions in the city. These masts were made of riveted boiler plate. They were erected *in situ*, and raised by jacks as they were made. The diameter is 8 in. at the top and 3 ft. at the bottom; they cost £800 each. I am bound to say that, to me, the effect was very poor; the streets were illuminated only by a light equal to a very pale moonlight, concentrated, as it were, at one end only. There are 300 other arc lamps in Cleveland. At St. Louis, the Court House in the centre of the town was surrounded by permanent arc lamps, but except for illuminating the dome of the Court House itself, the effect upon the contiguous streets was poor. Here one of the streets was lighted by two arc lamps on each pole on one side of the street, and the effect was certainly indifferent, and gave one the idea of a great waste of light. Washington has been experimentally illuminated by the Brush-Swan Electric Light Company, by very large arc lamps, 4,000 candle-power each, fitted with large conical reflectors, throwing a great body of light down the streets to be illuminated. The various avenues radiating from the Capitol are thus lighted, and a circle of 14 lights, without reflectors, surrounds the top of the Capitol, the effect of which, I am told, is certainly very fine. I have since learned, however, that, after an experimental run of 45 days of these lights, the commissioners empowered to decide upon the success of the experiment have give their veto against its continuance. It is, perhaps, interesting to point out that the price paid in New York is 70 cents per night, or £50 per annum for each arc lamp; but a fine is inflicted on the lighting company of $1.40 for each time that each lamp is reported to have been out; a healthy check is thus kept upon the good working of the system.

II.—INCANDESCENT SYSTEMS.

Incandescent lighting in America does not seem to have flourished to the same extent as arc lighting, nor indeed has it been applied to private houses to the same extent that it has in England. The principal system in practical use is that of Edison. Some incandescent lamps have recently been introduced by Mr. Weston that promise to be very efficient indeed. They are made from a material that Mr. Weston calls "Tamadine," the result of some secret process upon nitro-cellulose.

The Swan Lamp is extensively used principally by the Brush Company.

The Bernstein, a new lamp which was exhibited at the Health Exhibition, is also commencing to get a footing in the States.

House Lighting.—House lighting has been attacked principally by the Edison Company. The Edison Company have a grand central station in New York, which was opened on the 3rd September, 1882, and during the whole of the period that has elasped from that time to the date of my visit, there had been only two and a half hours' stoppage, that being due solely to carelessness. A commodious building in Pearl street is applied to this purpose.

There are now 587 subscribers, using altogether 12,764 lamps, served day and night; and present arrangements of the company are quite inadequate to supply all the applicants who desire the light. The price charged is the same as that which would be paid if gas were supplied at 7s. 9d. per 1,000 cubic feet, but there is every reason to believe that the rate is too small, and does not give a sufficient margin of profit. The price of gas is 9s. 2d. per 1,000 cubic feet. It is interesting, however, to know that the system is worked at a profit, and that during the past twelve months the balance on the right side has been sufficient to pay a dividend of 3 per cent. on the capital invested, but no dividend has yet been declared. The earnings per lamp hour are 1.04 cents, while the cost of production for the same period is .75 cents. The average number of hours of lighting appears to be 2.4 per day per lamp. A record is kept of every lamp, so that the average life is known, and it comes out at about 477 hours.

The average number of lamps per subscriber is twenty-one, while the average amount paid annually by each subscriber is £40.

The difficulties that have occurred in practical working have arisen principally from a too free use of fuses, which have given much trouble by going when they ought not to go. The conductors have, unfortunately, been fitted with bad joints, and a good deal of annoyance has arisen from leaks in the mains; but all these effects are due to imma-

* Paper read at Society of Arts on Wednesday, December 3.

ture experience, and can readily be remedied in future extensions.

The distribution of the currents is carried out by a network system of double mains which involves the use of an immense weight of copper. Dr. Hopkinson in England, and Mr. Edison in America, have shown how an economy of 60 per cent. in the weight of copper used can be effected by using three wires and two dynamos.

The whole area of the portion of the city lighted by this system is about a quarter of a square mile, it covers fifty blocks of buildings and fifteen streets, and the capital invested is £300,000. It is intended to open two more central stations, of much larger dimensions, in the upper part of New York, and there is no doubt that with the experience gained the troubles encountered in the old station will be remedied.

At Roselle I saw an interesting installation. This is a small village in New Jersey. There, 1,200 lamps were used, supplied by three dynamo machines joined up in series; the lamps also being worked in three series. Overhead wires were used, and the charge was 1 cent per hour for each 10-candle lamp; this is equivalent to gas at 2.5 dollars per 1,000 cubic feet.

Another very interesting central station, wired up on the new 3-wire system, was established at Brockton, a town about 17 miles from Boston. There were 2,090 lamps going, and 1,040 were about to be started. The station was installed in October, 1883, with 250 lamps, and the rate charged was 1 cent per hour for each 10-candle lamp. There were 108 subscribers. The capital of this company is $100,000, 25 per cent. of which belongs to the parent company. The station has not yet earned a dividend, but the expenditure balances the receipts. The business is growing at such a rate that there is no doubt that at the end of the second year a handsome balance will be realized.

I also inspected two large central stations in New York, worked on the Weston high tension system. One station worked 384 arc lamps, while the other was working 500 arcs and 1,750 glow lamps. All the details of these two stations manifested the same mechanical skill and solid appearance that I have already alluded to as indicative of the Weston system.

Conductors.—In all cases throughout the whole of the States, with the exception of the Edison system, the conductors are invariably aerial wires, generally of copper, protected to a certain extent with cotton or hemp covering, and supported by poles fixed along the curbs of the streets. The high tension currents are always used, and up to the present moment the freedom from danger has been very marked. A considerable amount of trouble has been caused to the telegraph and telephone companies by these powerful electric light currents finding their way into the telephone and telegraph circuits by contacts. I traced no less than seven fires in offices which were undoubtedly due to these causes.

Secondary Batteries.—The use of secondary batteries has not received so much attention in the States as on this side of the water. The form most generally in use is that of Mr. Brush, which is a modification of the Planté cells, and is said to give very good results. Another modified Planté I saw in use at Philadelphia, made by Dr. Starr. The experiments that have been made with the Faure secondary battery were not well spoken of.

Instruments for Measuring Purposes.—The point connected with electric lighting to which I devoted a considerable amount of attention was the practical working of Edison's method of measuring the current used, by the electrolytic action of a small portion of the current upon two zinc electrodes immersed in a solution of sulphate of zinc.

The bottles containing the solution and the zinc electrodes are collected every month, and in the Edison district of New York two men are employed whose sole duty it is to collect and measure these "meters." The plate which has suffered loss of zinc is removed from each bottle of the meter, dried, and carefully weighed. The mean between the two measurements is taken as the true one, and this weight of zinc lost, in milligrammes, multiplied by a co-efficient, gives the number of dollars to be charged for the light consumed during the month. The charge made to the consumer, though based on the current supplied, is really charged on the light given, and it is 1 dollar per 1,000 candle-hours. The weight of zinc lost is made equivalent to so many candle hours, and the subscribers, therefore, pay for the light they receive and not for the current they use.

There are 1,160 bottles out, 50 of which are measured every day. No trouble whatever is experienced in measuring them, and they are unquestionably accurate within 1 per cent., which is more accurate than any existing gas meter. The consumers themselves have taken various steps to check the reliability of the meter returns, and the result has been that the public has gained confidence in the accuracy of the measurements and the charges made.

ELECTRIC LIGHTING ON SHIPS.

The electric light has been applied to a great extent to the lighting of ships. The great ferry-boats of the Pennsylvania Railroad are so lighted. Those magnificent hotel steamers that ply between New York and Fall River, and those on Lake Superior, as well as those on the Mississippi and other large rivers, are either wholly illuminated, or are gradually being fitted for that purpose. The fittings on such a steamer as the *Bristol* are very complete, and were carried out by the Edison Company. All the great passenger steamers crossing the Atlantic are being fitted, and the comfort to passengers in consequence is inestimable.

GENERAL COMMERCIAL POSITION.

The problem as to whether electric lighting is practical, and as to whether that means of illumination can be made to pay, has been thoroughly solved in the United States. The Edison Company started on the basis of the charges made for gas, and the result of the two years' working has been to show that this was a financial mistake. Electricity must earn its future success entirely upon its merits and not on its economy. In the case of street lighting it has proved itself to be a good thing, and if once a thing is proved to be good in America, it is immediately taken up. "Progress" in that country is the word.

I have said, more than once, that at the present day we can only regard the electric light as a luxury, and we must pay for it as a luxury. But there is no reason why it should always remain a luxury. There are various chances of economy which justify the conclusion that, sooner or later, the price will be brought down so as to relieve us of the use of the term luxury as applied to it. For instance, the output of the dynamo can be extended, which has already been done with several types, particularly, as I have pointed out, in the case of the Brush pattern, where 60 arc lamps are now lighted where only 40 lamps were supplied by the earlier and unimproved machine.

Again, considerable reduction in the weight, and therefore in the cost, of the conductors has been made by the production of the three-wire system. Moreover, when existing patent rights lapse, the manufacture of dynamos will become general, and the consequent competition will, no doubt, result in the production of efficient machines at a sum far below the cost of those made under existing patent rights.

The efficiency of the glow lamps has also been very considerably affected by the improvements made, for instance, by Messrs. Woodhouse and Rawson, and by Mr. Bernstein. The efficiency of the Edison lamps means the consumption of energy at the rate of five watts per candle with an equal life, but lamps are now being made which give an efficiency of 2.5 watts per candle, which is equivalent to an immediate reduction of 50 per cent. in the amount of energy required to maintain the system alight, and, therefore, at the cost of its production.

There is still vast room for economy, and it is quite clear that the prices which are now necessary to make the electric lighting pay must not be regarded as final; they will be brought down.

Even now it is possible, in England, to make a system pay at the rate of a halfpenny per glow lamp per hour; and no one who has ever experienced the charm and comfort of the electric light, and who has electricity brought to his door, and supplied to him at this rate, would hesitate to pay that figure for the use of electric lamps, although he could obtain the same light by gas at less than half the price.

Odd and Unpleasant.

A harmless yet ghastly scarf pin is a mechanical skull of enameled gold, with a movable under jaw, and with diamonds set back in its hollow sockets for eyes. Prof. J. A. Schultz, the prestidigitator, wore one on a recent visit to the City Hall, New York. The little ornament was a marvel of the jeweler's art. It was enameled in perfect imitation of a bleached human skull, and a bright colored gold jockey cap fixed to the top of it added to its ghastliness. A reporter had his eye upon the skull while the Professor was talking to an Alderman, when suddenly the under jaw of the skull began to rattle and the diamonds in the eye sockets rolled and flashed. The chattering of the jaws could be plainly heard ten feet away and was calculated to draw attention. The Alderman and the reporter observed the chattering about the same instant. It had a fascinating and awe-inspiring effect upon the City Father, who stood spell-bound for an instant and then acted as though he doubted his vision. The chattering and eye-rolling would stop for a moment, as though the skull was tired by the exertion of rattling its tiny teeth together, only to be renewed the next moment with more vigor. Finally the reporter's professional instinct got the better of him and he besought the Professor to tell him all about the arrangement. The latter complied with a hearty laugh over the effect of his little joke.

"In the first place," said he "the skull is worked by a current of electricity generated by a little battery which I carry in my pocket, and transmitted over wires no heavier than strands of thread."

He illustrated the working of the ornament by pressing upon a button which completed the electric circuit and caused the teeth to rattle.

"It was made in Paris," resumed Mr. Schultz, "and is worth $100; at least that is what its duplicate will cost any person who wants one. Yes, the price is rather steep; but you must consider that the ornament has to be very carefully and nicely adjusted, and that it is made of platinum and the best of gold; besides, the diamonds alone are of some value. No; no cheap counterfeits have yet been made. The lowest-priced one I ever saw was marked at $65."

Laughing over recollections of some of the sport he had had with the pin, the prestidigitator resumed: "I frightened a darky almost to death with it yesterday. The man was so much frightened that his knees knocked together and his nostrils expanded just as I have seen those of a horse in alarm. I had to take the pin to pieces and explain all its details to completely overcome his fright."

Electricity for the Elevated Roads.

Prof. Moses G. Farmer has furnished to Mr. Cyrus W. Field an estimate of the cost of operating the Second Avenue Elevated Railway of this city by electricity, as compared with steam. He says:

I assume that a stationary plant can be erected somewhere near the middle of the line, not far from Sixty-third street, this plant to consist of one or more stationary steam engines of the best type, capable of developing one horse-power by the combustion of 1¼ pounds of coal per hour per horse power, by the use of such coal as does not cost over $2.50 per ton of 2,240 pounds.

I assume that there are in use on this line twenty locomotives of 110 H. P. each at the busiest hour of the day, and that each locomotive consumes—per H. P. per hour—5 pounds of coal that cost $4 per ton of 2,240 pounds.

I assume that the rails now in use are of steel and weigh 70 pounds per yard, and that a central steel rail of 70 pounds per yard will be laid for the purpose of conveying the electric current to the motors.

I assume that one mile of such steel rail will offer about 1-20 of an ohm's resistance, and that the aggregate internal resistance of the dynamos concerned in producing the current will not exceed 1-200 of an ohm.

I assume that from this central station sufficient current will be supplied to both tracks to energize at the same instant all of the twenty electric locomotives, no matter on what part of the tracks these motors may be situated.

I assume that 1 H. P. is the equivalent of 746 ampère-volts, and that 20x110x746 = 1,641,200 ampère-volts, in the aggregate, reach these motors.

I assume that such dynamos can be constructed as shall convert 90 per cent. of the mechanical power applied to them into current electricity, and I also assume that such electric motors can be constructed and used as shall convert 90 per cent. of the electricity which they receive into power used to draw the trains which are attached to them.

I assume the Second Avenue railway to be six and a half miles in length.

With these assumptions I have calculated the following tables:

TABLE I.

Volts.	Present power.	Future power.
500	2,200	3,369
1,000	2,200	2,879
1,500	2,200	2,787
2,000	2,200	2,757

TABLE II.

Volts.	Present coal.	Future coal.	Saving per hour.
500	11,000	5,895	5,104
1,000	11,000	5,039	5,961
1,500	11,000	4,889	6,111
2,000	11,000	4,825	6,175

TABLE III.

Volts.	Present cost.	Future cost.	Saving per hour.
500	$19 65	$6.58	$13.07
1,000	19 65	5.62	14.03
1,500	19.65	5.46	14.19
2,000	19.65	5.38	14.27

Table 1, column one, contains the electromotive force developed by dynamos at the central station; column two contains the H. P. required by the twenty locomotives; column three contains the H. P. that must be used at the central station in order to deliver at the electric locomotives the equivalent of 2,200 H. P.

Table 2, column one, contains the electromotive force, as in the first table; column two contains the hourly consumption of coal by the twenty locomotives now in use—5 pounds per hour per H. P.; column three contains the amount of coal consumed by the stationary engine that develops 1 H. P. by the combustion of 1¼ pounds of coal per hour; column four shows the saving in pounds of coal per hour made by substituting the better engine, the dynamo, the electric motor and the rail circuit.

Table 3 shows the hourly saving in dollars and cents by the substitution of electricity thus applied for the coal now used in the locomotives.

It will be seen from this last table that the lower and safer electromotive force of 500 volts is only about 9 per cent more expensive than the four times as great 2,000 volts, and about 7 per cent. more expensive than 1,000 volts.

I must reserve for another letter my conclusions regarding what would be the saving resulting from the use of electricity on the Third avenue line, as I wish to obtain some further information as to frequency of trains, etc.

In Austria.—It is reported that the Oesterreichische Nordwestbahn is about to adopt the electric light at Königsgrätz Station, which is 3,280 feet long. The cost of installing twelve 1,000 candle arc lamps is estimated at $12,000, and the expense of maintenance at $2,900 yearly, while a hundred paraffine lamps, giving a light of 2,400 candles, cost $3,250.

Underground Telephone Wires in Brooklyn.

Few controversies in the domain of practical electricity have been waged with so much vigor as that regarding underground wires. The pros and cons may not be argued very actively just at the present time, but the question has by no means been definitely settled. American electricians have so long been accustomed to the use of the unsightly pole that they have come to regard even its defects with admiration, and the evidence offered them in favor of an infinity of underground schemes has hardly ever been of a satisfactory character. But the action of various legislatures has compelled in many instances a resort to underground systems, whether tried or not, and the ever-increasing number of electrical services to be performed by means of wire conductors has induced the leading companies to make tests in their own behalf. Hence the present time is one of compromise and experiment. It has from the first been insisted upon by this journal that on proper inducement in the way of cheapness, security and efficiency being offered, the electric light, telegraph and telephone companies in the great cities would all endeavor to take at least their trunk lines below the surface of the streets; and the large sums of money now being spent by them on underground work is sufficient evidence of their earnestness in this matter. The day when every single wire will be buried is as remote as ever, and any enactment to that end will not be operative. What can be done to relieve the streets of the main lines will be done. Telegraph, telephone and burglar alarm companies are not anxious to keep their wires exposed to contact with electric light wires, and the concerns selling electric light will willingly adopt any feasible plan of "block" wiring. The charge for linemen is not so inconsiderable that electrical companies will dismiss it from their calculations in approaching this subject.

Underground work is therefore deserving of close attention at this time, and all the data of theory and practice should be collected for analysis. One of the latest efforts of the kind has just been made in Brooklyn by the New York and New Jersey Telephone Company, who have three exchanges in that large and growing city—Brooklyn, Williamsburg and Greenpoint—with a subscribership there of not less than 2,000. The Brooklyn exchange has close upon 1,200 subscribers, and it is centrally situated on Fulton street, close to the City Hall; and the object of the company has been to put as many of the wires underground there as possible, running the cables in that way clear of the business portion of the city, and coming to the surface to make a distribution of the wires at the best points. For part of their work the company have used the Callender system, a full illustrated description of which was given in THE ELECTRICAL WORLD of Nov. 15. Briefly described, this system consists in the use of insulated conductors placed in a light sectional iron trough having insulite ridges on which the cabled conductors rest, and into which, cementing the whole in a solid, impervious mass, the material "bitite" is poured. Once laid in this way the cables are perfectly insulated, and yet, as there is no heavy masonry or other conduit to deal with, they can be got at, for making way service or for repairs, as easily as gas pipes. The Callender system appears to have been remarkably successful everywhere. In Brooklyn, six Callender cables, stranded, of 50 wires each, have been laid in the immediate vicinity of the Exchange. They all run together about 800 feet from the Exchange, then open out into a Y, one leg of which represents the wires running in three cables about 100 feet to Washington street, and the other leg the wires for Fulton street. The wires are in groups of seven, No. 20 copper, and the cable is about 1¼ in. diameter. The trench in which the wires were laid was a simple spade excavation, going about 30 inches below the paving of the road.

These cables meet the others in a large manhole at the door of the exchange. While the Callender Company have done this section, the N. Y. & N. J. Company have done another important section themselves, running across the City Hall Square to Court and Remsen streets, down Court to Pacific, and branching on Atlantic Avenue to Boerum Place. The greatest length is 2,300 ft., the shortest 700 ft., and the cables used are Western Electric Co.'s and Brooks lead-covered, of fifty conductors. One of the cables has 100 wires. These cables are buried in a conduit of remarkably ingenious construction, the recent invention of Mr. J. C. Reilly, the Superintendent of the Long Island Division of the company's service. It is made of creosoted 1½ in. plank and divided into compartments 2 × 3 in., each compartment being intended to carry one cable. After the conduit is laid the cable can be drawn through with the utmost ease. All along the conduit in each compartment, at distances of four feet, are little rollers working on a spindle which runs through the width of the box. By means of these rollers, which spin freely at the slightest touch, the cable is hauled in with the minimum of friction. The writer saw *one man* pull out one of the heavy lead cables without a strain to himself or the least scratching of the lead covering, although the cable ran over 200 yards and around a sharp curve. The feat is hard to believe in unless it has been seen. Of course this conduit can be made in as many sections one above the other, or one alongside the other, as desired; and there is no reason why it should not last for a very long time. Mr. Reilly has certainly hit upon a very happy idea, and it will not be strange if it is extensively availed of in future work throughout the country.

Altogether about 200 miles of conductors have been put underground by the company, and thus at least three-fourths of the wires running into the Central Exchange have disappeared from sight. It should be stated that on entering the building from the basement, the wires are carried up to the exchange in a closet accessible from the stairs, and then are carried under the floor of the operating room to the distributing boards. Everything in connection with the arrangements is neat and compact. Mr. W. D. Sargent, the General Manager, informs us that the work will cost altogether between $15,000 and $20,000. An expenditure so large, in dull times, is a pretty good evidence of the desire of the company to give underground wires a fair trial.

Practical Work of the Wires in Brooklyn.

From the able and interesting report of Fire Commissioner Poillon, to the Mayor of Brooklyn, for the year ending November 30 last, we extract certain facts and figures exhibiting the important part taken by the telegraph and operators in the preservation of good municipal government and protection to life and property. The Commissioner says:

As the city has grown, a paid fire department has been organized, telegraphy has been introduced as one of the necessities of such a department, fire alarm boxes have been purchased from time to time and located where most required, and the bell tower has outgrown its usefulness in Brooklyn as in other large cities, in most of which it has been discarded.

Of twenty-eight alarms received from the four bell towers during the past year one was a false alarm, six were for bonfires and four were for fires outside the city limits; the apparatus of the department being called out unnecessarily in each case. Of the remaining seventeen alarms it is believed the majority, if not all, would have been promptly received from other sources had the towers not been in operation. When it is considered that these towers were maintained at an expense of at least $3,000 per annum, including salaries of bell ringers, and that the cost of receiving the seventeen alarms mentioned above exceeded $700 per alarm, not taking into account the wear and tear of the apparatus when called out unnecessarily, there can be no doubt that the $12,000 thus expended would have afforded greater protection to the city had the amount been applied to the purchase of street fire alarm boxes.

There are now 139 street and 70 private fire alarm boxes in use. All line batteries centralize at the Fire Commissioner's headquarters. Two hundred miles of wire are now in use on working circuits, running through 146 streets, 15 miles of which were strung during the year.

All alarms of fire received were promptly transmitted and 434 ambulance calls were sent through this bureau to Police Headquarters. The telegraphic system will be considerably strengthened during the coming year by the addition of fifty new street fire alarm boxes, provision for which is made in the budget for 1885. As the city is expanding so rapidly, with the prospect of still more rapid increase in the future, the importance of large and frequent additions to this part of the fire service cannot be too strongly urged.

Regarding the much discussed question of underground wires, Mr. Poillon reports: The most feasible plan for placing electric wires underground is one that is now absorbing the attention of scientific men. While a great deal has been done experimentally to decide this much vexed question, the problem apparently yet remains unsolved, though that a practical solution of it will be reached at no distant day there can be no doubt. Necessity has so ordained. As yet, however, opinions differ, and of all that have come to the notice of this department it would appear that the one expressed by Professor Houston, electrician of the Franklin Institute of Philadelphia, an authority on electrical matters, is most worthy of attention. That underground systems for electric light, telegraph and telephone purposes have been maintained to a limited degree, he says, is beyond question; but their greater safety over aerial wires is by no means certain. The question of underground conduits will be settled when the ready accessibility so as to permit of daily inspection of wires has been obtained, and this would appear to be possible only by systems of subways." Mr. John P. Barrett, city electrician of Chicago, also a noted authority on this subject, in considering the advisability of placing wires underground in that city, attributes the trouble and apparent failure experienced by certain corporations in laying cables to the fact that the latter are not properly protected, and gives it as his opinion that a proper way out of this difficulty would be to first determine the best form of conduit and, as the city improves, to have the conduit form a portion of the improvement. "Sufficient capacity could be secured in one conduit," he says, "to accommodate all lines. Should this prove successful, others could be constructed. I am certain," he states still further, "that if such a tunnel or conduit were built the telegraph companies would gladly avail themselves of such an improvement and pay a fair rental for the use of same. The fund derived from such a rental could be used to extend conduits in other portions of the city, and we would be gradually released from the pole nuisance." At the request of your Honor, an estimate of the cost of placing the wires of this department under ground was submitted to you on August 28. This estimate was based upon the cost of the system of the Pittsburg Underground Company, which of all the systems employed seems to give the greatest satisfaction, and as then submitted called for an expenditure of $322,360.00. In its operation the effect upon this department of the passage of the Underground Telegraph bill would seem to indicate that the passage of a bill affecting such great interests and susceptible of so rigid an interpretation was premature, and that some modification thereof at as early a date as possible should be made, so that a city covering so large an area as does this, and one expanding so rapidly, a city dependent so largely upon its telegraphic facilities, and becoming daily more dependent upon them, may not be left unprotected. Growing constantly, as Brooklyn is, with the prospect of still more rapid growth in the future, until some thoroughly practicable plan has been discovered for placing its wires underground all necessary work should be allowed to continue unchecked and needful improvements in and additions to its telegraphic system to be made. It is perhaps inadvisable to question the superior wisdom and foresight of our legislators, yet it would appear that the passage of a bill before a practicable way of complying with its provisions has been discovered is injudicious if not arbitrary.

A Change of Tune.

An illustration of the fact that "things is sometimes mighty unsartin" is the report of the Gulcher Electric Light and Power Company, of England, for 1884, issued last month, when contrasted with a like document, from the same source, of date 1882. The 1882, rose-water-and-bouquet paper recites that a contract had been entered into with Mr. William Crookes, F. R. S.; the G. E. L. & P. Co. buying his incandescent lamp on very favorable terms, it being "by far the most perfect invented both as regards durability and economy." The directors also delightedly announce that Mr. W. Crookes has accepted a seat on the board, to give the great assistance of his well-known experience as an electrician, etc. A special factory was constructed at Battersea for the manufacture of Crooks incandescent lamp at the rate of over one thousand per week. The price paid the inventor was originally $175,000; he was also to be the consulting electrician of the Co., at $2,625 per year, with his son, at $2,500, as superintendent of the incandescent lamp department of the factory.

But the onward march to fortune of the company was not all sunshine, or cheered "by the bright light" of the superior Crookes incandescent lamp; in fact things looked black, and the directors blue, and the last report (1884) states that Mr. Crookes surrendered last autumn half the amount of his fully-paid-up shares; that more lately he retired from the post of consulting electrician, also that he had received up to that time $8,890, paid in fees and salary to himself and son, with $38,500 in cash, $20,000 in bonds and $65,250 in paid up shares of the company as the purchase money for his lamp, together with interest up to date upon so much of the purchase money as from time to time remained unpaid.

The sum of $20,325 was expended before the company decided that, after paying Mr. Crookes the amounts mentioned, "notwithstanding the most persevering and intelligent endeavors on Mr. Henry Crookes' part to produce a good lamp, he is unable, and never has been able, and the board see no prospect of his ever being able, to manufacture a marketable article."

The company got rid of Prof. Crookes, but has his "failure" on hand and is still taking back and refunding money for lamps that have been sold. So the company asked the professor to return half the cash paid him and take back his patents, and the professor told the company that he "couldn't see it, not by those incandescent lamps," or words to that effect, and so the company has brought an action against him "for the return of the whole of the purchase money, with damages for the losses the company has sustained, and they trust that the shareholders will support them in the course they have thought it their duty to pursue."

"With a reasonable capital and a still further reduction of its standing expenses and by ceasing to manufacture the Crookes incandescent lamp, the directors are confident that a good future would lie before the Gulcher Electric Light and Power Company, Limited."

Prof. Crookes is a disfinguished scientist and it will be interesting to have his side of this picturesque narrative.

MEETING AND ELECTION.—On the 12th inst., at Portland, the Consolidated Electric Light Company of Maine held its annual meeting. There was decided interest manifested and stockholders were present from Lewiston, Lowell and Boston. The President's report exhibited a most flourishing condition of affairs, and an election of officers for the ensuing year resulted as follows: George A. Thomas, President; Franklin J. Collins, Vice-President; F. A. Sawyer, Treasurer; Clarence Hale, Clerk. Directors: W. A. Cromwell, Silas Gurney, Edw. H. Goff, Abel Wheeler, Wm. M. Wood, and all the officials.

Electric Motors and the Elevated Railways.

From an interview with Prof. Chas. B. Cross, Thayer Professor of Physics in the Massachusetts Institute of Technology, situated in Boston, we cull the following opinions, expressed by the scientist, regarding the application and use of electric motors upon the elevated railways of this city, the Professor having been invited to act as a member of the expert commission to test the electric motors and apportion the shares in the company which it is proposed to form by the consolidation of the companies now owning the motors which are competing for a place on the elevated railways of New York.

While Professor Cross has not decided if he will serve on the commission, he is fully interested in the important questions involved and results to be determined. He says:

"The importance of the matter involved is very great, both scientifically and pecuniarily, and I think the number of scientific members of the commission should be increased, and as the mechanical problems involved are as important as the electrical, the commission should have practical mechanical engineers in its membership. I do not know what experience as mechanical engineers the railway presidents selected may have, but certainly the composition of the commission should be very carefully considered before it is intrusted with absolute power to decide questions of such magnitude as those which are to be submitted.

"The decision of every question involved can be safely intrusted to Sir William Thomson, and he is about the only man of whom I could make such an assertion; but will he serve? His duties are very onerous and he might not be willing to be absent from Glasgow University for another trip to America during the college year. However, it may be possible for him to undertake the task to which he is invited if the test of the motors can be deferred until his summer vacation.

"There is much disagreement, even among experts, as to the methods of testing electrical apparatus, and it is difficult to secure an agreement as to the comparative merits of electrical machines. However, the Philadelphia Exhibition did much toward the establishment of correct methods of making tests, and I regard the testing of dynamos there as the most satisfactory work of the kind yet done. It will be more easy for the expert commission to perform its alloted task because of the tests made at Philadelphia, but it may require a considerable time to determine what motor is best and what system should be introduced.

"If electricity can be substituted for steam as motive power on railways, there will be a vast amount of money for the inventor who produces the motor which performs the desired services. I do not say that I doubt its possibility, and I will say that I think electricity can be advantageously substituted for steam on the elevated railways if anywhere, but there are so many things connected with the enterprise which are yet to be determined that I am not willing to express any opinion as to the results of the experiment.

"Pres. Morton, of the Stevens Institute of Technology, is very conservative, but even he estimates that the Manhattan Company can save about 30 per cent. by the substitution of electricity for steam, and the other electricians who have expressed their opinion are much more sanguine. I think the change from steam to electricity will be advantageous, pecuniarily, but I will not venture any prediction as to the per cent. to be saved. I think the problem to be considered by the commission is extremely important, both scientifically and pecuniarily, and I prefer to hold my opinion in reserve until investigation has removed some uncertainties which now enter into the case.

"The chief factors in the problem—the amount of power required, or the cost, or the risk to life and property—each of the three is important, but I do not think there will be danger in the use of electricity to move railway trains if proper precautions are taken. I should not hesitate to receive the shock of the current used on most of the electric railways now in operation, although their traffic is nothing like that of the New York elevated railways. I should say roughly that about 500 volts with a 1,500 ampère current would be approximately the equivalent for the steam power now employed, not taking into the consideration the element of waste in heating the wires. It might be advisable to use lower electromotive force and a higher current. There ought to be no danger in the use of even a much stronger current than I have mentioned. The lower the number of volts the stronger must be the current, and consequently the greater will be the risk.

"As to the cost, that must be ascertained by a test. The problem is to obtain the maximum of energy at the minimum of expense. The earlier dynamos were constructed with a great internal resistance, but that resistance has been much reduced in the recent inventions. The water-wheel gives the greatest per cent. of the original energy, and in some wheels it is as high as 95 per cent., but the recovery in some of the dynamos is said to be as high as 96 per cent., so that the prospect from an economical point of view is encouraging, but not sufficiently so to warrant the expectation that electricity can be substituted for steam on all railways; the change is probably feasible only on short lines with light trains.

"To the railways contemplating the substitution of electricity for steam as motive power I would say, go ahead. I would like very much to have the change now under consideration by the Manhattan Railway Company effected. They have begun in the right way, I think. Let them carry out their plans and ascertain whether the contemplated change can advantageously be made. The consolidation of the motor companies and the introduction of the best motor obtainable for the elevated railways of New York are results much to be desired.

"The invitation to act as a member of the commission is one not be lightly accepted or declined, and I shall carefully consider the task before I give my reply. I certainly hope Sir William Thomson will be able to accept."

The Orne Battery.

For a long time electricians have been experimenting to obtain a battery, using an acid liquid for an excitant, in which there would be no chemical action when the circuit is open. Among recent improvements in electrical apparatus of this kind is the Orne battery, which is said to accomplish the purpose in a satisfactory manner. This battery is made by the Orne Battery Company, of 837 Main street, Cambridge, Mass., and is illustrated below. It is composed of a piece of carbon 4 inches long, 1½ inches wide, ¼ inch thick, and a porous cup 3 inches long and ¾ inch in diameter, filled with a mixture of zinc and mercury. The carbon and cup are placed in a frame and suspended in a glass jar. The jar is filled with a solution of sulphuric acid and bichromate potassa. The electromotive force is 2 volts; resistance, 3 ohms; current, .66 ampère. There is claimed to be no local action, thus giving the full value of zinc and acid in electrical work. It is clean, does not give off acid or

corrosive fumes, has no formation of crystals or evaporation of solution. The connections do not corrode. There is no consumption of zinc when the circuit is open. It will last from six months to two years before it has to be refilled. When the battery has to be renewed, there are no parts to throw away; all that has to be done is to refill the jar with acid solution, and place a piece of zinc in the porous cup. Every part is movable. The same amount of surface of amalgam or zinc and mercury is always presented to the acid. If the circuit gets accidentally closed, the battery is so constructed that it runs only five minutes and then stops working, thus saving waste of zinc and acid and the use of automatic cut-outs. It can be brought back to its original strength immediately by rinsing the porous cup with water. This action is due to the rapid formation of dry sulphate of zinc on the inside of the porous cup, thus separating the amalgam of zinc and mercury from contact with the solution.

It should be stated that any solution can be used with this battery; but a solution made as above gives the strongest current. The level of the mercury amalgam being above the level of the solution, the latter is prevented from flowing through the walls of the cup and dissolving the zinc when the battery is at rest. In the cut, *A* is the porous cup, *B* the amalgam of zinc and mercury, *C* the hollow rod of zinc, *D* the brass rod, and *E* the stopple.

The American Electrical Exhibition, Boston.

The various exhibits at the above exhibition have at last taken shape so that preliminary notes may be made of some of them.

The Bell Telephone Company make a fine exhibit of things pertaining to their system, which will be noted in detail by and by. The Dolbear Telephone Company has two stations at the exhibition. The Dudley Manufacturing Company of Boston has an exhibit of telephone calls, etc. Blodgett Bros. & Co. of Boston exhibit an electric railway signal train dispatcher, etc. Seth W. Fuller & Holtzer of Boston have an attractive exhibit of electric goods, such as gas lighters, hotel annunciators, etc. Washburn & Moen, of Worcester, have a fine exhibit of iron, steel and copper wire. The Anglo-American Cable Telegraph Company has a characteristic exhibit of its system of telegraphy. In arc lighting, the Weston Company shows a number of its arc lamps, and the White House Mills Company, of New York, has 32 of its Arago lamps in various parts of the building, nine being in the tower, their illumination at night forming quite an attractive feature. In the west end of the hall the miniature Bijou Theatre proves a great attraction to visitors. Mr. W. S. Hill has a small elevator run by the electric current, and other novelties. In the gallery, the principal attraction and novelty is the Bidwell electric railway. The police signal system of the Municipal Signal Company, of Boston; the Martin Automatic Fire Alarm Company's exhibit, and the American Watchman's Fire Detector Company, of New York, have some stations, there being 13 in all in the building; the Security Electric Signal Company of New York has an exhibit in the same inclosure; the Orne Battery Company of Cambridge shows its new battery and its application; the Rhode Island Telephone Electric Company has a characteristic exhibit; the Time Telegraph Company of New York has a time-keeping central station, from which, through its licensees, the Rhode Island Telephone and Electric Co., it distributes time to indicators throughout the exhibition building; Rueter & Houghton of Boston have two stations showing their intensity telegraph system; Orcutt's electric signal is shown on the gallery, and the American Automatic Fire Alarm Company has also an exhibit; Palmer & Batchelder's electric orchestrion is in the gallery, and grinds out music by electricity, and it may be added that the electric pianos aid in the electric harmony that should prevail among electrical people. The Edison companies make a fine and tasteful exhibit, which is in charge of Mr. E. H. Lyon.

The exhibit of the fire department of the city of Boston includes the following:

1. The Channing and Farmer original fire alarm signal box. The one shown is one of the first ten boxes made when the system was adopted by the city of Boston, April 28, 1852. It was located at the corner of India street and Central wharf, and was used in open circuit, with return wire to central office.
2. Improved box, introduced by Channing and Farmer in 1852, and used in closed metallic circuit.
3. The last of the crank boxes, made in 1865.
4. The first automatic box in use. This system was introduced in 1867, and some of the boxes are still used in the city.
5. The present style of fire-alarm boxes.
6. The keyless box door, which was introduced in 1883 and which is now in use in the business portion of the city.
7. A magneto-electric generator, made by John Polsey about the year 1860, to supply current for striking fire alarms on church bells. It was run by a water motor, and was discontinued about 1868. It contains 16 pairs of permanent compound magnets, eight pairs on either end, attached radially to a metal plate on either end, and facing one another, with opposite poles. The armature is in the form of a wooden wheel, with its shaft not unlike the wheel of a wheelbarrow, only much larger. Into this wheel a number of holes are bored in direction parallel with its axis, into which the bobbins or electro-magnets are inserted to the number of 24. These electro-magnets consist each of a core of fine iron wires about 1½ inches in diameter, which are wound with No. 16 insulated wire, the diameter of the bobbins being about 4 inches.

It is thought that now the bad weather has ceased the attendance will be much larger, Bostonians being quick to appreciate the practicability of the modern applications of science.

Aerial Navigation.

In the communication by Monsieur D. Stapfer, engineer, to the *Genie Civil*, he maintains that whatever be the practical value of Captain Renard's aerial ship with electrical motor, it is interesting to note that he has demonstrated the possibility of calculating the elements of the aerial ship according to the formulæ used in water navigation. Thus the experiments of the 9th of August last have demonstrated that the resistance per square metre of midship section is in direct proportion to the densities of the fluids. That is to say, that the air having a density 800 times less than sea water, the engine which could propel 800 square metres section in the air could only propel one square metre immersed in the water. In fact, if to the air ship is applied the well-known formula:

$$V = m\sqrt[3]{\frac{F}{B^2}},$$

We find $V = 5.50$ m. per second $= 11$ knots per hour.
$F = 250$ kilogrammetres $= 3.3$ horse-power.
$B^2 = 55$ square metres, or 0.0687 of water.

From which the coefficient m is found to equal 3.00, which corresponds to the factor used in a ship of full body. Monsieur Stapfer therefore concludes that in future it will be an easy matter to predict the velocity which an aerial ship can attain according to the gross power developed by the motor, save such changes as are due to fineness of form or disposition of motor. But it remains an acquired fact that for an air ship of 2,000 kilogrammes of ascensional force it requires 3½ horse-power to overcome a wind of six metres per second velocity, popularly termed "a good breeze for driving

windmills." Thus, to overcome an aerial current of nine metres per second, it will be necessary to develop 12 horse-power, as Messrs. Renard and Krebs had predicted; and Monsieur Stapfer regrets that, having had an electric motor capable of developing as its limit 12 horse-power for over an hour, they did not continue the voyage until they had exhausted their power, and were contented to develop only a little more than three horse-power during 25 minutes.

The Telephone in New Orleans.

To the Editor of The Electrical World:

SIR: Allow me to make a few corrections and comments on the various parts of "Explorer's" letter, dated Dec. 6, that interest the National Improved Telephone Co., of New Orleans. As your accredited correspondent here, he explains the fact that although the correspondent of an electrical journal he is confronted with the fact that the exposition is not an electrical one. I should think from this that as he says there is so little information to obtain in regard to things electrical he would have no difficulty in reporting the little there is. As an independent journal I presume you are willing to give the most reliable news to your readers, whom I believe pay you their subscription for that purpose, at least I do. Allow me then to state the belief that your correspondent did not seek any further information than what he obtained at the northwest corner of the main building, or more plainly the Exposition office of the Great Southern T. & T. Co. I am the more confident of this from the fact that he states that in the neighborhood of the main entrance there are offices for the press and telegraph, the neighbor of these offices being the Bell or Great Southern Co. He seems to be aware that we have a good location, and where that location is, and, as a correspondent of a newspaper which claims no partiality in the matter of anything electric, one would have thought that he would have sought for information concerning this company from their headquarters. As your correspondent has shown such poor judgment in the gathering of news, allow me to try and do better. In the first place, far from being depressed by Judge Wallace's decision, we are very much elated, as that is just what we wished for. If your correspondent had called upon us he would have found that we were showing anything but a depressed condition, and he would have found us as he terms us, "gentlemanly," and willing to give him correct information regarding ourselves and business. We thank him for the term, "gentlemanly," as we have so far been termed "sharks" by the "gentlemanly" manager of the Great Southern Company here. Again we have, instead of twenty wires in the main building, forty wires distributed in the main and Government buildings and through the grounds. We have the contract to furnish the entire telephone service to the Exposition, including thirty offices in the city. We have our location under the Music Hall stairway, which location we are using as an exchange for the Exposition lines, and we are using the space for business purposes and not for Exhibition purposes. Again we have paid the first installment of the pole tax demanded by the city, which is five dollars per pole, and we don't miss the amount so much that we care about getting into lawsuits with the city. We have two hundred miles of bare and insulated wire on hand to be used immediately the Council decides to let us use square instead of round poles. We have fifteen miles of No. 16 hard-drawn copper wire in use at the grounds. We have over one hundred telephones delivered here, the first lot of one thousand. We are not using, nor intending to use, Rogers' invention, but the combined inventions of four other inventors, making over fifty legitimate and practical inventions. We are using a multiple exchange system, too, for which there are eight patents filed and most all allowed. As to the single telephone output, we have had six all summer.

In conclusion I would like to state that there are no Muller lights in use here, as the Louisiana Company have decided to use and are using the Excelsior lights and machines. If your correspondent desires any information, he will find us, as the proper parties, always ready to talk to him, but we claim that information derived from a competing company is unreliable.

Hoping, as an independent paper, not controlled by any particular corporation, you will be willing to accept the proper information from us, ONE OF THE SHARKS.

NEW ORLEANS, Dec. 17.

Electro-Motor Driver.

To the Editor of The Electrical World:

SIR: A friend called on me to-day and upon my asking him the name of his four-year-old boy he replied that inasmuch as his wife and his wife's family wished the child to be called *George*, and he and his family favored the name of *Douglas*, the boy had not yet been christened, and he was not sure that he ever would be, judging from the existing appearance of things.

It struck me that this was much the same condition of affairs as exists with regard to the appellation of the man who drives the electro-motor. One side of the house wants one name and the other side of the house another.

For my part, I do not quite see that the exigencies of the case require such an elaborate discussion as has been called forth.

We call the man who drives a locomotive engine *a locomotive engineer* or *a locomotive engine driver*. The man who attends a stationary engine, a *stationary engineer* or *stationary engine driver*. The fire engine driver, a *fire engine driver*. Thus we have the street car driver, the bob-tail-car driver, the stage driver, and numerous other drivers. Why not call the man who drives the electro-motor, an electro-motor-driver? It is not so long a word as locomotive-engine-driver, and is, in my humble opinion, quite as euphonious.

Besides, how often would we use the word when referring to that important person? I do not know what custom prevails in other establishments, but in ours when we want him we merely say "Where's Pat?" and everybody in the place knows at once that we refer to the electro-motor-driver—that's pat!

Before closing, permit me to call the attention of our punsters to the fact that they have not as yet seized the opportunity of comparing a coulomb with, for instance, a warm ohm—in doing which, however, pray do not set me down as a promoter of puns. W. MAVER, JR.

NEW YORK, Dec. 17.

THE TELEGRAPH.

BADLY DISCOUNTED.—On Thursday, 17th, at Petersburg, Va., the sheriff sold, by public auction, $19,500 of the Southern Telegraph Company bonds; denominations, $1,000, $500 and $250, at the rate of 17 cents on the dollar.

W. U. TAXES IN MAINE.—The Attorney General of the State of Maine has been legally dunning the Western Union for taxes due the State from that company. About ten days since the W. U. gave over the fight, stepped up to the "Captain's office," and settled the full bill with interest.

DOUBLE DEALING.—The Connecticut District Telegraph and Electric Company send both information and illumination over their wires. The company are running seventy-nine arc lights in Waterbury and have a district telegraph system at Meridien and Bridgeport, about 500 boxes being rented in the two last-named cities.

IN PHILADELPHIA'S COUNCILS.—Last week, by the Quaker City's ruling powers, ordinances were passed authorizing the Baxter Overland Telephone and Telegraph Company to lay conduits for wires and electrical conductors in certain streets; extending the time for removing telegraph poles from the streets one year.

IN HUNGARY.—From the returns of the Minister of Communications, it appears that the length of telegraph lines in Hungary at the end of last year was 16,223 kilometres (10,080 miles), the wire measuring 54,149 kilometres (36,754 miles). There were 542 State telegraph offices, and 706 belonging to railway companies. The persons employed numbered 223 women and 1,442 men.

A RECEIVER APPOINTED.—At Norfolk, Va., on Dec. 20, in the United States court, the injunction case against the Southern Telegraph Company was called, in which William Mahone and other bondholders charged general mismanagement on the part of the telegraph company and asked that a receiver be appointed. After some discussion as to jurisdiction the court decided to grant the injunction and appoint a receiver on Monday, the 22d inst. The receiver's bond was fixed at $100,000.

THE TELEGRAPH IN DENMARK.—*La Lumière Electrique* gives the following statistics for 1883 of the Telegraphic Department of Denmark: Total length of line, 1,500 miles; offices, 152, not including 165 railway telegraph offices lately opened to the public and the offices in the maritime fortifications now also available for public use. Telegrams sent, official, 2,313,830; public, 1,247,281. The receipts show a favorable advance over the preceding year, amounting to 685,583 kroner, which is about $191,365.

LONG LIVED CABLES.—In 1865 a cable was laid between Kreesbran and Haardt, near Bregenz, by the Wurtemburg Administration of Telegraphs, and it continued in uninterrupted use until a short time since, when it became inoperative, and upon raising it out of the water a complete rupture was discovered, the conductors and wires of the armor being gnawed asunder. Upon renewing some 1,800 feet, however, it was found to work as well as when new. Between Fredericksbaven and Romanborn there is now a cable in excellent order that has been laid for thirty years.

THE B. & M. CO.—Several share and bond holders of the Bankers and Merchants' Telegraph Company held a meeting on Friday, 19th inst., to suggest, discuss and, if possible, adopt self protective measures. That something ought to be done to prevent the property from going to complete ruin was admitted by all present, and into the hands of a committee, consisting of Dwight Townsend, John A. Washburn and William G. Davis, were committed the interests of the security holders for care, when some concerted action on the part of the bondholders has been taken.

VEXED OPERATORS.—The operators in the Western Union Telegraph office in Buffalo waxed indignant over several orders of dismissal which went into effect on Dec. 20. The cutting of the "extra" work arrangement, by which they were accustomed to increase their salaries by from $15 to $20 per month, had also had an irritating effect. "Reduce expenses" was the order that came from New York, and it seems to have been left to the discretion of the manager to make the saving as he saw fit. Mr. Tillinghast discharged five of the best operators, Craig, Cook, Kerling, Baker and Ernest. All of these men were drawing salaries of $80 per month outside of the "extras." Craig was the press dispatch operator and was noted in all the newspaper offices as the "operator with a Spencerian hand." All the others are splendid men, but were among those who struck a year ago last July. The operators would like to strike, but do not feel that it is the right time of the year. They sympathize with the operators at New Orleans, but do not apprehend that there will be any trouble there. Some of the victims have secured places with other lines.

THE TELEPHONE.

THE TELEPHONE AS A WEATHER PROPHET.—By observing and comparing the sounds emitted by a telephone connected by leads with two iron bars, stuck into the ground a few metres apart, it is possible to have an indication of the coming weather, sometimes ten or twenty hours in advance. So says *Le Franklin*. In case of a thunderstorm, especially, a noise like that of shriveling leaves increases until a flash of lightning occurs, when it resembles that of rain or hail falling on glass.

AN IMPORTANT DECISION.—In the Supreme Court of Wisconsin, at Madison, on the 16th inst., a decision was rendered of considerable importance to telephone companies. Some time ago the common council of Oshkosh demanded $300 license per annum from the Wisconsin Telephone Company for operating lines in the city, in default of which a removal of the lines was threatened. The company complied, but protested payment, and afterward brought suit for recovery of the money. The lower court held that defendant's answer, to the effect that it was empowered to remove obstructions, and that the ordinance granting the company authority to erect lines was not valid, was insufficient. The supreme court sustained the decision.

A CENTRAL AMERICA ENTERPRISE.—The Guatemala Telephone Company has been organized in San Francisco with a cash capital of $25,000, to operate the telephone business under a government concession for Guatemala, Central America, and under license from the Inter-Continental Telephone Company and sub-contract with Messrs. Wendell & Phillips, of Boston, who control the Central America business. Mr. Samuel Hubbard, formerly in charge of the Bell telephone business in Honolulu, S. I., sails this week for Guatemala with 100 complete sets of Bell and Blake instruments and central office outfit to established the system in that city and manage the company's affairs. One hundred subscribers are already engaged, and it is expected that 200 subscribers will be secured and put in telephone connection in 1885. The officers of the company are: R. Toledo, president; H. C. Hyde, vice-president, and John Lloyd, secretary and treasurer.

THE ELECTRIC LIGHT.

THE ROYAL ELECTRIC LIGHT CO., of Canada, has received the contract for lighting the entire city of Ottawa for three years, with a prospect of a renewal for five or ten years more. They have also received several other large contracts.

THE E. L. IN CARRIAGES.—The Trouve lamp electric light, which has frequently been seen in Paris lately, has now been introduced into England, and a private one-horse brougham, well equipped, drove along one of the principal thoroughfares in London a short time since, brilliantly lighted by means of electricity.

MADRID WANTS THE E. L.—The high rate of coal and lack of demand for its sub-products, render the price of gas so high at the Spanish capital that there is a demand and movement for the establishment of a central station with two alternate current Gordon dynamos to supply 12,000 lamps.

A CENTRAL LIGHTING STATION AT BANGOR, ME.—To supply arc and incandescent lights and electric motors for transmission of power by the establishment of a central lighting station, a company has lately organized at Bangor, Me., with capital of $50,000, and for a 100-arc light plant, with accompanying machinery for incandescent lights and motors, to be furnished immediately, a contract has been made with the American Electric and Illuminating Company of Boston.

THE ENGLISH ELECTRIC LIGHTING ACT.—The suggestion made by the President of the London Board of Trade to the deputation which recently waited upon him, that clauses should be submitted to the Board embodying the desired modifications of the Electric Lighting Act and Provisional Orders, is to be acted upon, and a committee consisting of representatives of the various electrical lighting interests is being constituted to draw up such clauses.

EMPLOYMENT OF THE E. L. IN FRANCE.—In France the Edison lamps have lately been installed at the following works: 50 at Loffin's lace manufactory, Candry; 40 at Chaffrées foundry, Le Mans; 50 and 8 regulators at Cointraux' distillery, Angers; and 25 at Lorthillor's spinning mills, Tourcoing. The offices and printing rooms of the *Neues Tageblatt* of Vienna have also been lighted by 300 Edison incandescent lamps fed by an Edison dynamo, the lamps in the offices being movable, with supple leads.

STUDYING ARTISTIC EFFECT.—A beautiful electric chandelier has lately been placed in the offices of the Consolidated and Sawyer-Man companies in the Mutual Life building, Nassau street. It is of antique design, and has rich lily-shaped bulbs of various colors around it. Suspended from the bottom of the chandelier is a large globe, pure white, containing a 50 candle-power light. The other lamps number thirteen and are of 16 c. p. each. Their arrangement is unique and very effective. The current for the fourteen lamps is furnished, it is stated, through a No. 18 conductor, in a flexible cord running from a small bracket in the wall. The whole works admirably, arguing well for the excellence of the system, and the sight is one the eye lingers on these dull days. The Sawyer-Man lights throughout the Mutual Life building have been highly praised during this foggy week.

GAS VS. ELECTRIC LIGHT.—There is a very lively competition between the gas and electric light companies of Montreal at present. The gas party have acted with considerable liberality and generosity in the way of charges and extra improved lamps for their customers and the city, but the electric light is surely gaining ground, and not slowly either. The Royal Electric Co. has now orders for more lights than can be supplied until new machines, being built, are completed. Of course there are two parties, each in favor of one of the rival lights, and the war will rage between the companies and their friends to the benefit of the general public, until the city authorities decide which of the two, gas or electricity, shall light the streets.

RAPID INSTALLATION.—Says *The Electrician*, of London: The ease and celerity with which temporary installations of electric light can be made has just been exemplified by Messrs. Woodhouse and Rawson, who recently lighted up Lady Filmer's residence at Maidenhead, utilizing Colonel Fremantle's dynamo and engine, a quarter of a mile distant. The work was only com-

menced at about eleven o'clock on the preceding morning; but the whole of the cable was run and the lamps were fitted up in time for the dance without any hitch, the lighting being perfectly steady during the whole evening. People having their houses permanently lighted by electricity can thus, by lending their currents on occasion, confer a considerable benefit upon their friends, as the electric light, owing to the absence of heat, greatly enhances the comfort of the guests at a dance, besides adding brilliancy to the decorations.

THE E. L. IN ENGLISH MILLS.—The introduction of the electric light into the mills and dye-houses in Bradford, England, is hailed with delight by the operatives. At the wool-scouring works, where the men have to work all night, the light is greatly appreciated, not only on account of the better light which they have to labor by, but also because the air is much cooler and purer than when gas is burning. In the dye-houses the arc light is used chiefly for "matching shades," and is, as a rule, very reliable, especially if none but good carbons be used, as a bad carbon causes spluttering and flickering, which makes the light change from a white to a violet tone, and *vice versa*, and so gives a wrong impression of shade to the dyer. The incandescent lamp is not much used for matching shades, as the light is too yellow, but it is very useful in gray-rooms, cleaning-rooms, etc., where benzine is used, and in any place where there is danger of fire.

APPLICATIONS OF POWER.

ELECTRICITY AS A MOTIVE POWER.—Sir Frederick Abel, Chairman of the Council of the Society of Arts, London, believes the result of recent tests seems to foreshadow a future for the employment of electricity as the motive power not merely of small pleasure boats, but of small vessels in which silent progression is a desideratum sufficiently important to counterbalance the defect due to the limited period during which the motive power can be maintained. The future of the transmission of heavy weights on land by means of electricity is not less full of promise. Prof. Jenkin is soon to make a practical application at Millwall, London, of his telpherage system for moving goods trucks by telfer lines suspended on poles as telegraph wires are now.

THE CREIL EXPERIMENTS.—M. Lazare Weiller will supply a cable with a core of silicious bronze for the Creil experiments. This cable is manufactured under the Berthoud and Borel patents, of which the Kinetic Engineering Company are the sole licensees in England. An order has been given for 78,000 metres (49 miles) of this cable, to be delivered as soon as possible. It is calculated to carry a current of 20 ampères with an E. M. F. of 7,500 volts, equal to 15,000 watts, or 200 horse-power. The *Bulletin* of the Cie Internationale des Téléphones states that testing some of the machines has shown the necessity of modifying the collectors, which did not answer their purpose with the currents of high tension employed. The weight of steel and cast iron in each receiver is about 4 tons, independently of the coil; and M. Marcel Deprez has found that the friction of the shaft alone, running light, absorbs 20 horse-power.

MISCELLANEOUS NOTES.

THE galvanometer of Deprez d'Arsonval has been applied to the measurement of the current which is necessary for the illumination of a Geissler tube. The galvanometer was regulated to give a scale division for each hundreth-millionth of an ampère. At the moment of illumination the current was 3,500 micro-ampères; it was gradually reduced until there was a sudden extinction at 150 micro-ampères. The experiment points to great advantages which may result from the use of the galvanometer in measurements of small intensities.

GETTING THINGS MIXED.—The genial president of the Knickerbocker Trust Company of this city tells a story which is not the less amusing for being true. A short time ago an elegantly dressed lady, of the "fair, fat and forty" description, entered the offices of the company and asked to see the president. Upon being shown into his office she inquired, in an undertone, whether he was selling electrical appliances. The president was dumbfounded for a moment; but the lady put him at once at ease by showing her absolute ignorance of the difference in the meaning of the words truss and trust.

INVERSION OF ELECTROMOTIVE FORCE.—A paper was read by M. F. F. Le Roux, at a recent meeting of the French Academy of Sciences, on an experimental demonstration of the inversion of the electromotive force produced by the contact of iron and copper at a high temperature. Results proved that under varying conditions, at about the temperature of 1,000 degrees, an electric current passing from the copper to the iron heats the point of contact, while cooling it at the ordinary temperature. *Nature* remarks that "a knowledge of this fact now for the first time demonstrated, may affect not only the theory of thermo-electricity, but also that of certain chemical phenomena."

INTERESTING TO ELECTRICAL INVENTORS.—The latest Official Gazette of the U. S. Patent Office contains the following notice: Appendix No. 2 to the index to patents relating to electricity covering the period of time from July 1, 1882, to June 30, 1883, has been issued, and is now for sale. These indexes, arranged alphabetically, numerically and by classes, are completed to June 30, 1883, and comprise the following volumes: Vol. 1, index to patents relating to electricity granted by the United States prior to June 30, 1881, with an appendix July 1, 1881, to June 30, 1882. One volume, 350 pages. In paper covers, $3; bound, $5. Vol. 2, Appendix No. 2, July 1, 1882, to June 30, 1883. One volume, 50 pages. In paper covers, $1.50.

THE NEW METAL DISCOVERER.—Mr. Frishmuth, of Philadelphia, a pupil of Herr Wohler and the maker by a new process of the aluminium from which the cap of the Washington monument has been wrought, has invented a method of substituting some cheap carbon compounds of sodium for the costly metallic sodium which is so dangerous in the process of manufacture. He also announces the discovery of a solder called the Emerson-Foote metal, in regard to which experts are most sanguine and enthusiastic. The aluminium is a better conductor of electricity than silver when alloyed with 90 per cent. of copper. Its strength is, weight for weight, greater than steel. It is lustrous in appearance and proof against corrosion. The Washington monument cap referred to above weighs 117 ounces.

DOCTORING BELTING.—Machinery belts ought thus to be treated, according to a trade journal: When a belt has been slightly injured by rain or by being wet in any other manner it should be dried as much as possible, and laps that may have started ought to be fastened by a little cement. A good cement for this purpose is made of equal parts of good glue and Russian gelatine dissolved in water and cooked in a tin vessel, constructed like an ordinary glue pot, until the mass is thick and ropy. The cement can be worked into the places which require to be united, by means of a knife. Then the belt should be hammered until dry. A few wooden pegs, such as are used by shoemakers, may be driven in. The pegs must be cut off a little from the surface on the reverse side, and hammered well down on a flat iron, lapstone or anvil.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange, and elsewhere are as follows:

TELEGRAPH.—Am. Cable, b 55; B. & M., b 2⅛ a 4; Western Union, b 56⅝ a 56¾.

The low prices in Western Union are to be attributed to the "bearing" of the market on the strength of reports that the dissatisfaction of the operators at the reduction of their pay might cost the company something. There appears no reason, however, for anticipating trouble on this score, neither party being willing to proceed to extremes.

TELEPHONE.—Am. Bell, b 263 a 264; Erie, b 19; Mexican, b 1⅝; New England, b 36 a 37; Tropical, b 1¼.

ELECTRIC LIGHT.—Edison, b 40.

BUSINESS NOTICES.

FITCHBURG ENGINES.—The Fitchburg Steam Engine Company are building two 85 horse-power engines for running electric lights in Lowell, and a 60 horse-power for the same purpose at Lawrence, Mass. The suitability of the Fitchburg engine for driving dynamos appears to be attracting widespread attention. The company have orders on hand also for several large engines in the east and west for paper mills, hosiery mills and other industrial establishments.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

Edited by EDWARD P. THOMPSON, M. E., Electrical Expert, 9 Murray Street, New York.

PATENTS DATED DEC. 9, 1884.

Adjustable Resistance for Electrical Circuits; F. J. Sprague, New York, N. Y., Assignor to S. Insull, Trustee..... 309,167

Consists of two series of metallic contacts, resistance-coils connected between them, and a circuit controlling arm for each series.

Circuit Controllers for Electric Clocks on Telephone and other lines; J. E. Smith, New York, N. Y., Assignor to the Gold & Stock Telegraph Company of same place..... 309,001

Consists of devices for setting clocks by electricity of non-polarized electro-magnetic shunts, which, during the ordinary use of the line or lines, keep the several clock-setting devices shunted, but bring them into circuit for synchronizing the clocks by the action of a re-enforcing current, other than that employed to do the ordinary work of the line.

Electric Battery; J. L. Roberts, Brooklyn, N. Y., Assignor of one-half to H. L. Breevoort, of same place..... 308,992

Consists of an electric battery in which *C* is a plate, preferably made of copper, *c* is the conductor attached to this

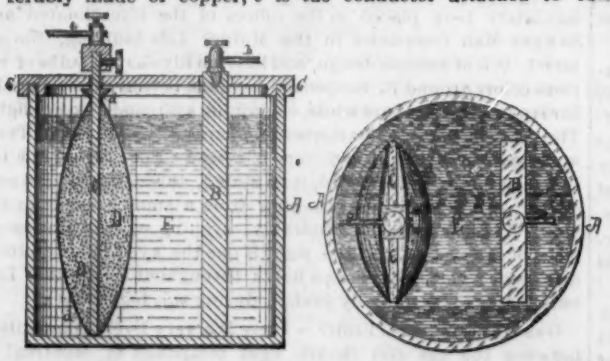


plate of metal or carbon. Surrounding the conductor *C* is a mass of copper peroxide, commonly known as "black copper oxide." This can be obtained in the form of copper scale. This material is held to the plate *C* by a bag *d*, or a porous cup. A bag of textile material fine enough to keep the black oxide of copper in place is the best.

District Telegraph Signal-Box; W. B. Palmer, Minneapolis, Minn..... 308,922

Comprises details of arrangements of spiral springs, rachet-wheels, pawls, etc.

Electric Apparatus for Setting Blocks Synchronously; J. E. Smith, New York, N.Y., Assignor to the Gold & Stock Telegraph Co., of same place..... 309,000

Consists of magnets for operating clock-setting devices and polarized shunts for controlling the passage of the currents through said magnets both in the primary circuit and in the secondary circuit or circuits.

Electric Arc Lamp; S. F. Van Choate, New York, N. Y..... 309,012

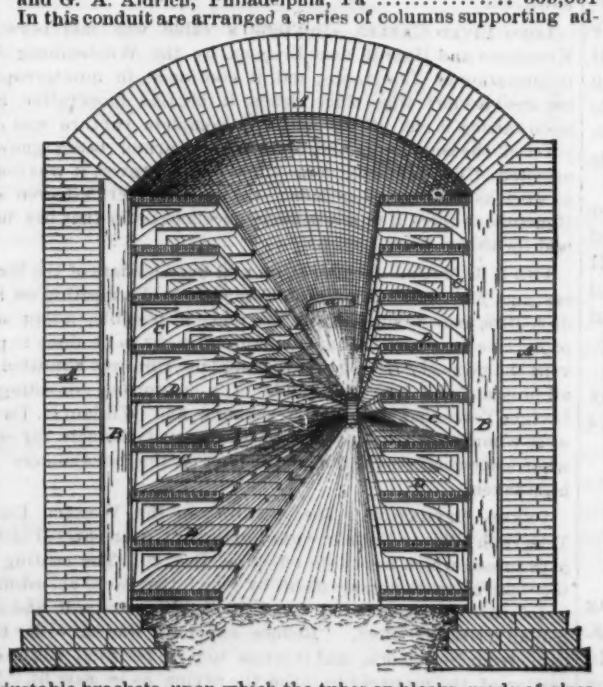
Consists of a hollow carbon-carrier and a spring-locking clutch attached to a stationary support and adapted to engage with the carbon, and an adjustable block or lug upon the carrier which impinges against the clutch as the carbon is moved up and down and removes the clutch from its locking position or allows it to lock the carbon.

Electric Gage; C. D. Warner, Ansonia, Conn..... 309,114

Consists of an electro-magnet designed to be placed in series with the working electro-magnets of the circuit, having an armature provided with a pointer and held normally in a position in which it is but partially within the field of force of the magnet.

Accessible Underground Conduit; W. K. Platt and G. A. Aldrich, Philadelphia, Pa..... 309,091

In this conduit are arranged a series of columns supporting ad-



justable brackets, upon which the tubes or blocks, made of glass, earthenware, or other suitable material, are supported, so as to be readily accessible.

Electric Wire Supporter; O. M. Draper, North Attleboro, Mass., Assignor by mesne assignments to himself and A. S. Weaver and O. N. Bender, both of Providence, R. I..... 308,954

Consists of a cylinder having the series of grooves in its outer edge, and extending from end to end of it, and an annular cylinder fitting over the first-named cylinder.

Low Water Detector for Steam Boilers; J. M. Palmatier, New York, N. Y..... 308,897

Consists of an electric conductor extending within boiler and insulated therefrom, an electric circuit having its terminals connected one with the said conductor and the other with said boiler, whereby the rise and fall of water is made to directly close and break the electric circuit, and an alarm apparatus controlled by the breaking of said circuit by reason of the level of water falling relatively to the conductor in said vessel.

Printing Telegraph; F. S. Pope, Elizabeth, and T. A. Edison, Menlo Park, N. J., Assignors by mesne assignments to the Gold & Stock Telegraph Co., New York, N. Y..... Reissue, 10,542

Consists of a polarized electro-magnet whose armature is operated by alternate positive and negative currents of short duration, a neutral electro-magnet placed in the same circuit, whose armature communicates its power directly to the printing-lever and is actuated by prolonged impulses of either polarity, and a type-wheel actuated or controlled by said polarized electro-magnet.

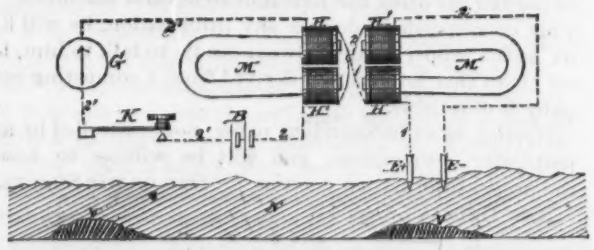
Telegraphy; R. K. Boyle, Brooklyn, N. Y., Assignor to himself, J. M. Pendergast, Boston, Mass., and D. H. Craig, New York, N. Y..... 309,126

Consists in mechanical details of construction.

Means for Electrically Locating Mineral Veins; A. P. Lighthill, Boston, Mass..... 308,908

Consists of two metallic electrodes capable of being turned into electro-magnets adapted to be set upon or be forced into the ground and connected through a galvanometer-key and some source of electricity.

We will first suppose the electrodes *E* to be inserted into the



earth at the point *N*, which is not near a mineral vein. Under these circumstances, the earth being dry, no current will pass and the galvanometer will be perfectly passive: but if the said electrodes be inserted at the point at which they are shown over vein *V*, a current will pass of sufficient strength to move the needle of the galvanometer perceptibly, the degree and rapidity of the movement depending on the size of the vein and its depth below the surface.

Telegraph Call-Box; C. H. Herman, New York, N. Y..... 308,897

Consists of a signal-wheel, notched engaging wheel to arrest and hold the transmitting mechanism in any one of the several positions in which it may be set, provided with a laterally-projecting pin and a bent lever, combined with a pawl, said mechanism operating to arrest the train and short circuit the box.

Telephone Transmitter; W. H. Eckert, New York, N. Y., Assignor to the American Bell Telephone Co., Boston, Mass..... 308,956

Consists in employing two sheets of metallic foil, forming both electrode-plates and a diaphragm, suspended side by side in contact with each other and below the mouth-piece of the transmitter. The electrode-plates are so bent as to form a V-shaped opening between them.